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MISSISSINEWA RIVER (PHASE 2) WATERSHED DIAGNOSTIC STUDY

A Lake and River Enhancement Project
funded by the Indiana Department of Natural Resources
Division of Soil Conservation
Indianapolis IN

For the Soil and Water Conservation Districts of
Delaware, Randolph, and Jay Counties

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The Delaware, Randolph, and Jay County Soil and Water Conservation Districts received a grant from the Indiana Department of Natural Resources Division of Soil Conservation through the Indiana Lake and River Enhancement Program. The purpose of the grant was to assist the districts make a diagnosis of water quality problems in the upper Mississinewa River watershed and propose solutions to fix the problems identified. A previous study (Phase 1) had been conducted on the uppermost sections of the river. This study (Phase 2) concentrated on the watershed between the towns of Ridgeville and Albany.

All available information on the watershed was assembled. Then new chemical and biological information was gathered. A computer model was used to predict ecological changes that may be expected to occur with changes in land use. Finally, the new information was used to identify problems in the watershed and work toward economical solutions.

The Mississinewa River is one of the largest tributaries of the Wabash River in northeastern Indiana. Land use in the watershed is dominated by agriculture, but many small forests and natural wetlands are also present. The watershed is identified by U.S. EPA as having a high potential for nutrient, sediment, and pesticide runoff. Within the category of agriculture uses, livestock production is very important, especially for hogs. There are 8 "confined feeding operations" with state permits in the watershed. The towns of Ridgeville, Albany, and Redkey are served by centralized wastewater treatment systems.

Water chemistry and biological samples were collected at twelve sites in the watershed and one site on a nearby "reference stream" (Stoney Creek), which previous studies had shown to be in excellent condition. Nutrient values at most sites were elevated compared to many other Indiana streams in agricultural areas, especially during wet weather. Other water quality measurements fell within ranges suitable for most forms of freshwater aquatic life.

E.coli bacteria, which represent the potential for health risk to swimmers, were present at concentrations exceeding Indiana water quality standards at most sites during wet weather. Concentrations were considerably lower during dry weather. The source of bacterial contamination is unknown.

Aquatic habitat was generally good at most sites, especially within the Mississinewa River itself. Habitat at some sites was impaired by channelization and lack of stream bank vegetation.

Computer modeling showed that the watershed would respond almost immediately to a 50% reduction in nutrient and suspended solids loading. A 36-month simulation of nutrient concentrations, water clarity, and fish using the model AQUATOX showed that nitrate, ammonia, and phosphorus would decline immediately. Even though the Mississinewa River watershed is relatively large within the Phase 2 study area, reductions in nutrients and suspended solids will increase the density and biomass of large game fish in the stream by about 5% within seven months after nutrient reductions occurred. The game fish density would continue to increase by 8% after 3 years. These types of improvements in biological productivity will be even greater on small tributaries within the watershed. For example, the biomass of benthic invertebrates is expected to increase by 27% within the first summer, while the number of game fish should grow by 17%.

Four tributary sub-watersheds were identified as areas where water quality improvements could be made. BMPs to address nutrients and *E. coli* were recommended for Fetid Creek. Several potential sites for wetland restorations were identified in this sub-watershed. BMPs to address excessive sediments were recommended for Elkhorn Creek and Mud Creek. Several sites with high slopes near watercourses were identified in these sub-watersheds, as well as on Days Creek. A site on Platt Nibarger Ditch was recommended for nutrient control. Livestock exclusion was recommended for one site. Estimated costs to reduce nutrient and sediment inputs in the watershed by 50% were about $400,000.

Halfway Creek and Heuss Ditch were identified as sub-watersheds where aquatic habitat restorations could be made. Recommendations were made for areas where channel modifications for drainage improvement are planned. These include limiting cutting of trees to only one side of the stream, doing channelization projects in small portions during a year, and keeping existing riffles in place. In addition, Halfway Creek water quality will be much improved when the Town of Albany fixes sewers that cause frequent overflows.

A public meeting was also held as part of the project on November 20, 2003 at Albany, Indiana. Twenty-eight people attended (a sign-up sheet is attached in the Appendix). The meeting explained the findings of the study and some of the possible outcomes. A project brochure was produced and is attached in the Appendix.

I. INTRODUCTION

A. BACKGROUND OF THE STUDY

One of the ground-breaking legislative efforts to clean up pollution in the country's rivers and lakes was the 1972 Federal Clean Water Act. The initial focus of this legislation was on establishing and enforcing standards for "point source" dischargers (cities and industries that used water and put it back into a stream or lake through a system of pipes). In the first decade of its existence, the Clean Water Act resulted in large improvements in water quality.

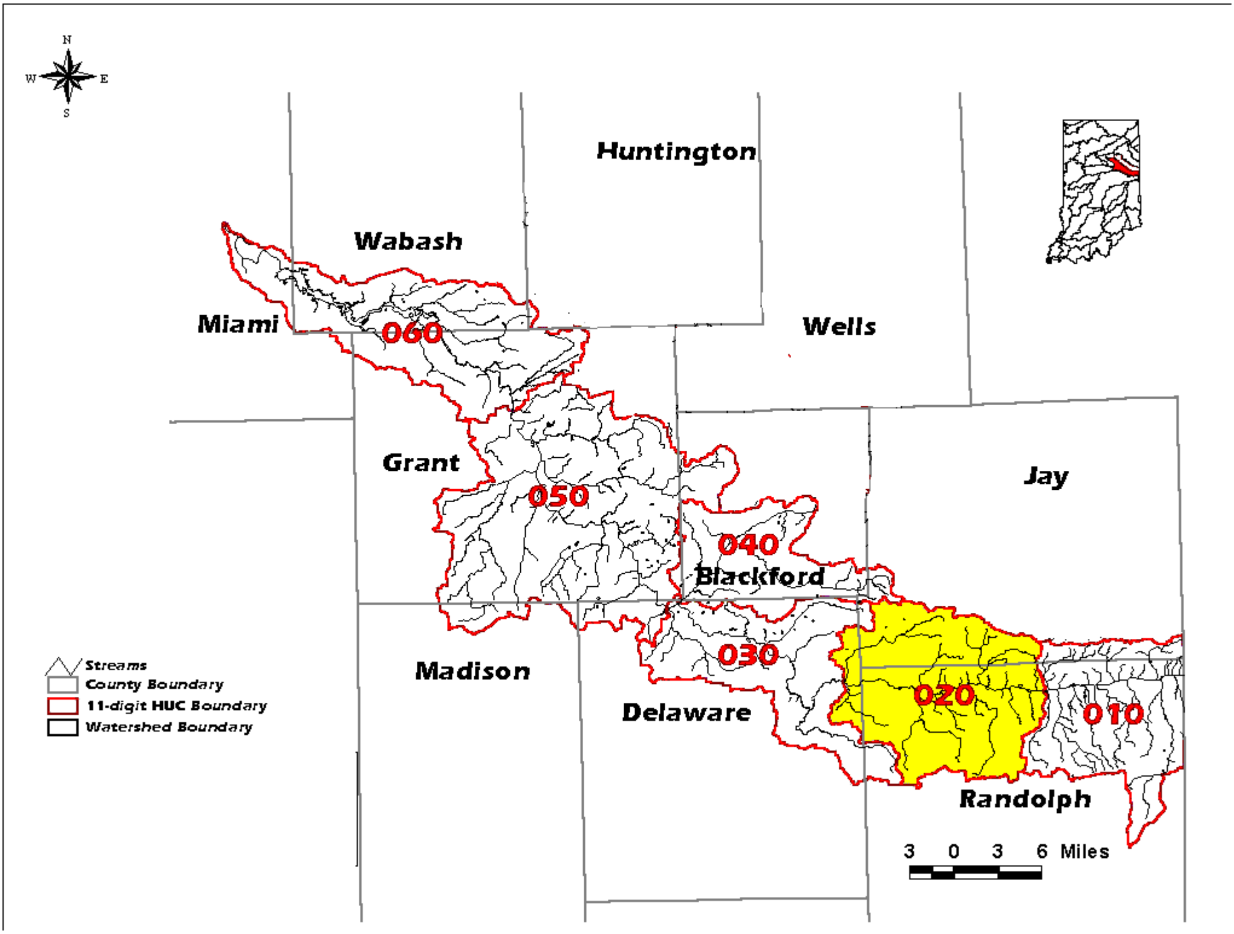
During the 1980's there was an increasing awareness by scientists that water quality was also impacted greatly by "nonpoint sources" of pollution. These were pollutants dispersed through atmospheric deposition or by diffuse sources of wet weather runoff. An important assessment of environmental conditions in the early 1990's [30] determined that nearly half of the nation's rivers and streams did not fully support their uses for swimming and fishing. The pollutants identified most often as contributing to water quality problems were siltation, nutrients, pathogens, and pesticides. Agricultural activities were determined to be the primary source of pollutants in 72% of the impaired rivers and streams.

In recent years, there have been many new federal, state, and local programs directed toward addressing nonpoint source pollution. The emphasis in many of these programs has been a "watershed approach," which encourages managers to examine all factors contributing to water quality problems within an entire area where a stream receives its flow. By addressing how land is used within a watershed and making plans for improvements in land use ("best management practices" or BMPs), the wet weather runoff into streams and rivers will be less polluted.

One of the state agencies responsible for water quality planning in agricultural areas is the Indiana Department of Natural Resources (IDNR), Division of Soil Conservation. They use the tax money collected every year from boat owners in Indiana to fund studies that help diagnose water quality problems in watersheds and assist in payment for some BMP implementation.

The Mississinewa River is one of the largest tributaries of the Wabash River in northeastern Indiana. In 1999 the Randolph County SWCD received funding from the Indiana Lake and River Enhancement (LARE) program of IDNR to study and prioritize water quality problems in the uppermost end of this watershed. The study study was completed in February 2001 [19]. The local SWCDs decided to seek additional funding to begin work on the next downstream segment of the river. A second LARE grant was received in 2002. The Mississinewa River and the most recent study area are shown in Fig. 1 (HUC 020).

Figure 1. Mississinewa River Watershed



B. STEPS NECESSARY TO FORMULATE A PLAN

1. Critical information gaps are identified.

2. Current conditions are described from available maps and land use information.

3. Water chemistry, biology, and habitat information are collected.

4. Computer models are used to predict changes expected to occur with potential changes in land use and management practices.

5. Specific problems in the watershed which could interfere with water quality are identified

6. Practical, economical solutions to the problems are identified

7. Specific sites for management are identified and their selections are justified

8. Potential project constraints (excessive costs, land uses, etc.) are identified. Available institutional resources already in place are assessed to determine their capacity for helping carry out the plan.

9. Potential sources of funding for future work necessary to carry out the plan are identified

10. An information handout explaining the plan (and made available at a public meeting) is presented

II. IDENTIFYING CRITICAL INFORMATION: WHAT DO WE ALREADY KNOW ABOUT THE WATERSHED?

A. ITEMIZED INFORMATION ABOUT THE WATERSHED

Harza, 2001. Watershed Diagnostic Study for the Upper Mississinewa River [19].

Water quality was examined in six sub-watersheds between Union City and Ridgeville. *E.coli* bacteria concentrations exceeded Indiana water quality standards at all sites. Aquatic habitat values were "fair" at most sites. Sub-watersheds identified for highest priority management were Mud Creek, Jordan Creek, and Miller Creek.

USGS, 1980. Drainage atlas of Indiana [1].

Drainage areas of the subwatersheds:

Mississinewa River upstream from Ridgeville	133 sq. mi.	
Days Creek		17 sq. mi.
Bear Creek		16 sq. mi.
Bush Creek		20 sq. mi.
Platt Nibarger Ditch		6 sq. mi.
Halfway Creek		25 sq. mi.
Mud Creek		12 sq. mi.
Mississinewa River at Albany	267 sq. mi.	

The total drainage area of the study segment (the Mississinewa River between Ridgeville and Albany) is 134 square miles.

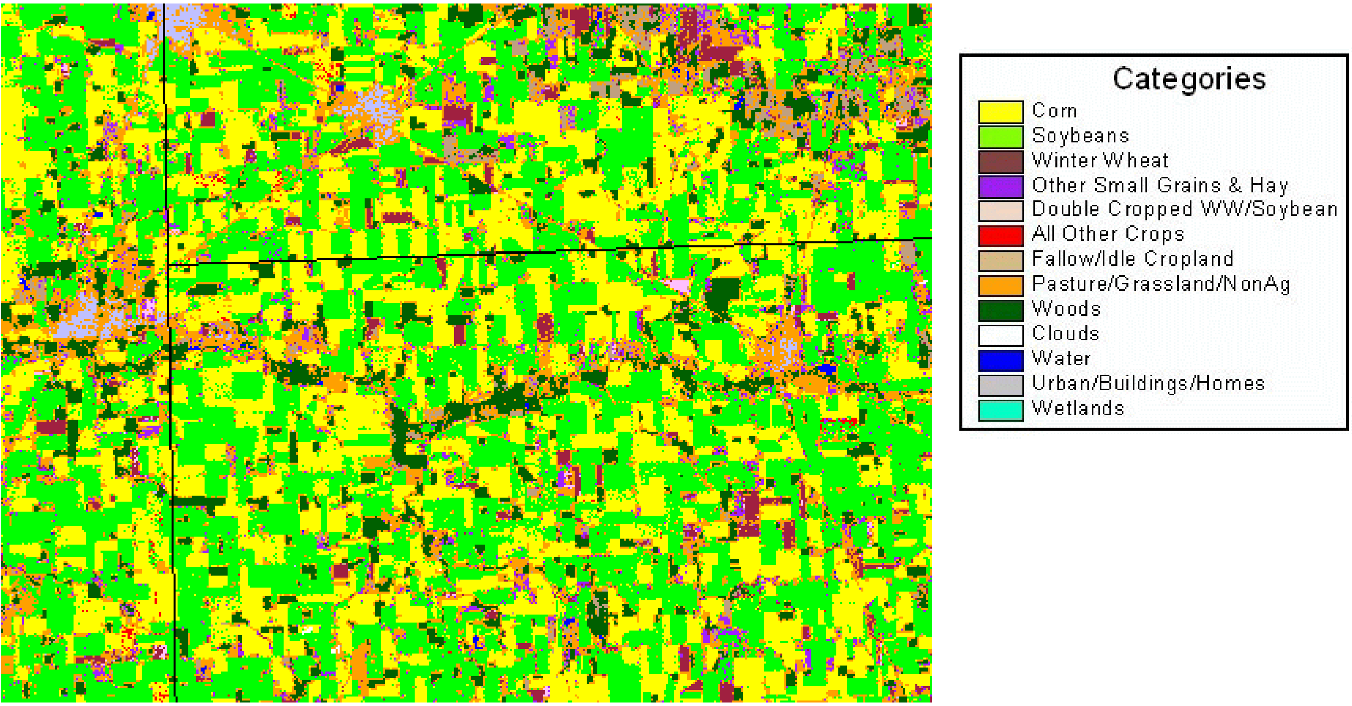
Purdue University, Department of Agronomy. Agricultural statistics for 2000 [12].

Land use within Delaware, Randolph, and Jay Counties (where this portion of the Mississinewa River watershed is located) has the following breakdown:

Agriculture: Corn	45%
Agriculture: Soybeans	45%
Agriculture: Wheat	2%
Pasture	4%
Woods	3%
Urban	1%

A detailed map generated by satellite imagery (Landsat 5 and 7) showing land uses within the watershed is displayed in Fig. 2.

Fig. 2. Land uses (Satellite data for 2000)



Indiana Department of Environmental Management, Unified watershed assessment data, 1999 [14].

Information includes local data on residential septic system density, livestock density, and cropland pressure. This portion of the Mississinewa River watershed has the following ratings (the scale ranges from 1 [low concern] to 5 [high concern]):

Septic System Density	1
Livestock Density	4
Cropland Pressure	4

The 11-digit HUC identification for this watershed is 05120103020. There are eight 14-digit sub-watersheds present (010 through 080).

USGS, 1989. Statistical summary of streamflow data for Indiana. Report 89-62, Water Resources Division, Indianapolis IN [2].

There is one gauging station in the watershed, on the Mississinewa River at Ridgeville. Average flow at this site is 126 cfs, but flows as low as 1-3 cfs are observed there during autumn in most years.

IDEM, 2002. List of impaired waterbodies (303d list) [21]

This segment of the Mississinewa River is on the impaired waterbodies list for Indiana due to PCB and mercury contamination in fish. There is a fish consumption advisory for this portion of the river.

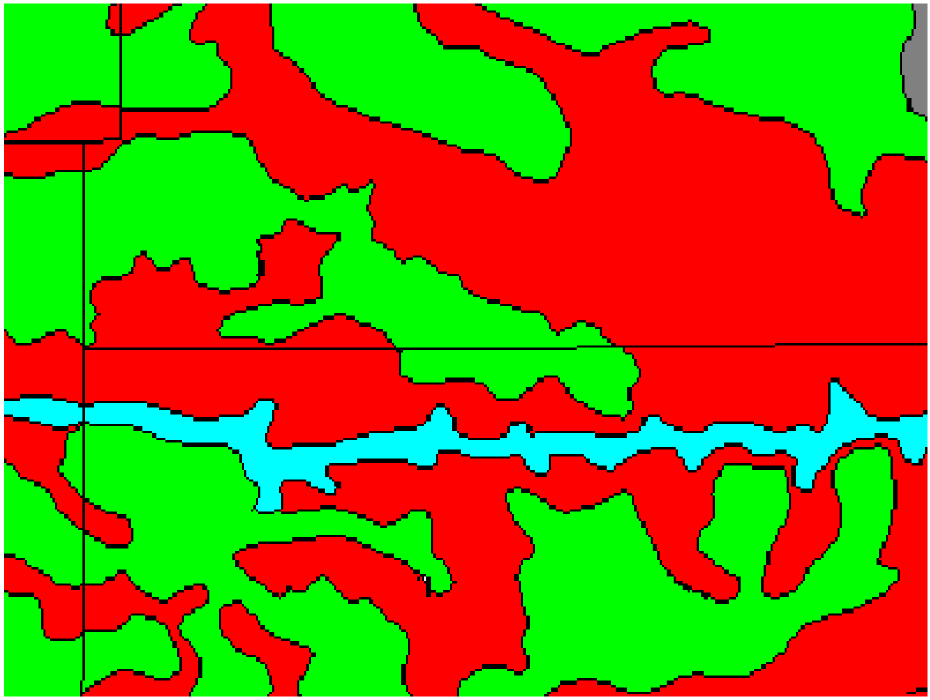
Homoya et al., 1985. The natural regions of Indiana [3].

This area is in the “Bluffton Till Plain” of central Indiana. Soils are generally rich in clays, formed under glacial influence. The area is poorly drained. In wetter sites, wetland trees such as red maple, swamp white oak, and green ash predominate. In drier areas, sugar maple, red oak, white ash and beech are the most common trees.

U.S. Department of Agriculture. Soil surveys of Delaware, Randolph, and Jay Counties. Soil Conservation Service. Available in the NRCS Indiana office, Indianapolis, IN [9-11].

There are three primary soil types in the watershed. These are mapped in Figure 3 and described below:

Fig. 3. Soil types



Green = Blount-Pewamo

Red = Glynwood-Pewamo-Morley

Blue = Eel-Sloan-Fox

Common characteristics of each soil type are:

Fox - loam - on stream terraces
Eel, Sloan - silt loam - frequently flooded
Blount, Glynwood - silt loam - on uplands
Morley - clay loam - well drained
Pewamo - silt clay loam - very poorly drained

The soil types most prone to water erosion are Morley and Glynwood (red areas). These have K values greater than 0.4 and may be present on steep slopes.

Eel-Sloan-Fox soils (the blue areas) are moderately prone to erosion. However, because they are frequently flooded, these soils can also be contributors to stream sediments when vegetation has been removed.

The soil type least prone to water erosion is Pewamo (green areas, in part). This poorly drained soil has a K value less than 0.3 and is present only on low slopes.

Simon & Dufour, 1997. Fish community data for the Mississinewa River [13].

As part of a study of all streams in this area, fish were collected from the Mississinewa River at CR 300 E and at Highway 1 in Randolph County in 1994. Fish diversity (species richness) was very high (27 species). The index of biotic integrity was 52 on a scale of 0 to 60 (good biotic integrity).

Ecological Specialists, Inc., 1995. A unionid status and distributional survey in the Salamonie and Mississinewa Rivers [22].

Ecologists made collections of freshwater mussels at five sites in the area. Twenty-four species were identified, including 8 species with live individuals and 2 others with "freshly dead" individuals. This is a relatively high diversity for a small stream in Indiana. No state or federally endangered species were present as living individuals.

EPA Pollution Compliance System Data for Wastewater Dischargers. 2001 [15].

There are five permitted wastewater discharges in the watershed.

Ridgeville Wastewater Treatment Plant
Redkey Wastewater Treatment Plant
Albany Wastewater Treatment Plant
Fairview Acres Mobile Home Park Wastewater Treatment Plant
Meshberger Brothers Quarry

Braun, 1999. Fisheries survey of the Mississinewa River in 1998 [28].

Habitat, water chemistry, and fish communities were collected from the Mississinewa River. Three sites were within the Phase II study area. The index of biotic integrity (IBI) values for these three sites were 48-54 (good biotic integrity), even though habitat (QHEI) values were somewhat low (63 to 70).

IDEM, 2004. Fish community data for Elkhorn Creek in 2003 [29].

Fish and habitat information was collected from Elkhorn Creek at CR 1000 W in Randolph County. The IBI score for this site was 36 out of 60 (fair integrity) while the QHEI (habitat) value was relatively low (45).

IDNR Natural Heritage Data. Division of Nature Preserves, 2002.

IDNR Natural Heritage specialist Ron Hellmich supplied information on uncommon species known to be present in the watershed. These are listed below. References for endangered animals is found in [4].

ENDANGERED, THREATENED AND RARE SPECIES,
HIGH QUALITY NATURAL COMMUNITIES, AND SIGNIFICANT NATURAL AREAS DOCUMENTED

TYPE	SPECIES NAME	COMMON NAME	STATE	FED	LOCATION	DATE
Mammal	LYNX RUFUS	BOBCAT	SE	**	T21NR11E 2 MI NW OF ALBANY	1984
Mammal	MYOTIS SODALIS	INDIANA BAT OR SOCIAL MYOTIS	SE	LE	T21NR11E 20 NEQ SWQ SEQ	1990
Vascular Plant	RUDBECKIA FULGIDA VAR FULGIDA	ORANGE CONEFLOWER	SR	**	T21NR12E 13 & 14	1938
DAVIS - PURDUE FOREST						
Bird	ARDEA HERODIAS	GREAT BLUE HERON	**	**	T21NR12E 23 SWQ SEQ	1993
Forest	FOREST - FLATWOODS CENTRAL TILL PLAIN	CENTRAL TILL PLAIN FLATWOODS	SG	**	T21NR12E 23 SWQ SEQ	1980

STATE: SX=extirpated, SE=endangered, ST=threatened, SR=rare, SSC=special concern, WL=watch list, SG=significant,** no status but rarity warrants concern

FEDERAL: LE=endangered, LT=threatened, LELT=different listings for specific ranges of species, PE=proposed endangered, PT=proposed threatened, E/SA=appearance similar to LE species, **=not listed

Christensen, C. 1998. Indiana fixed station statistical analysis [20]

The author analyzed eight years of water quality data from the Mississinewa River at Ridgeville during the 1990s. There were strong statistical declines in total phosphorus and chemical oxygen demand and a lesser decline in total suspended solids. At the same time there were small increases in dissolved oxygen concentrations and pH. These water quality analysis indicate generally improving conditions in the watershed.

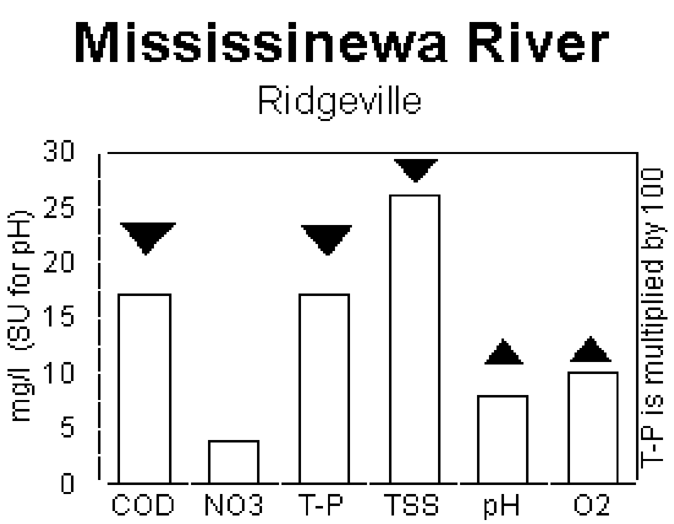
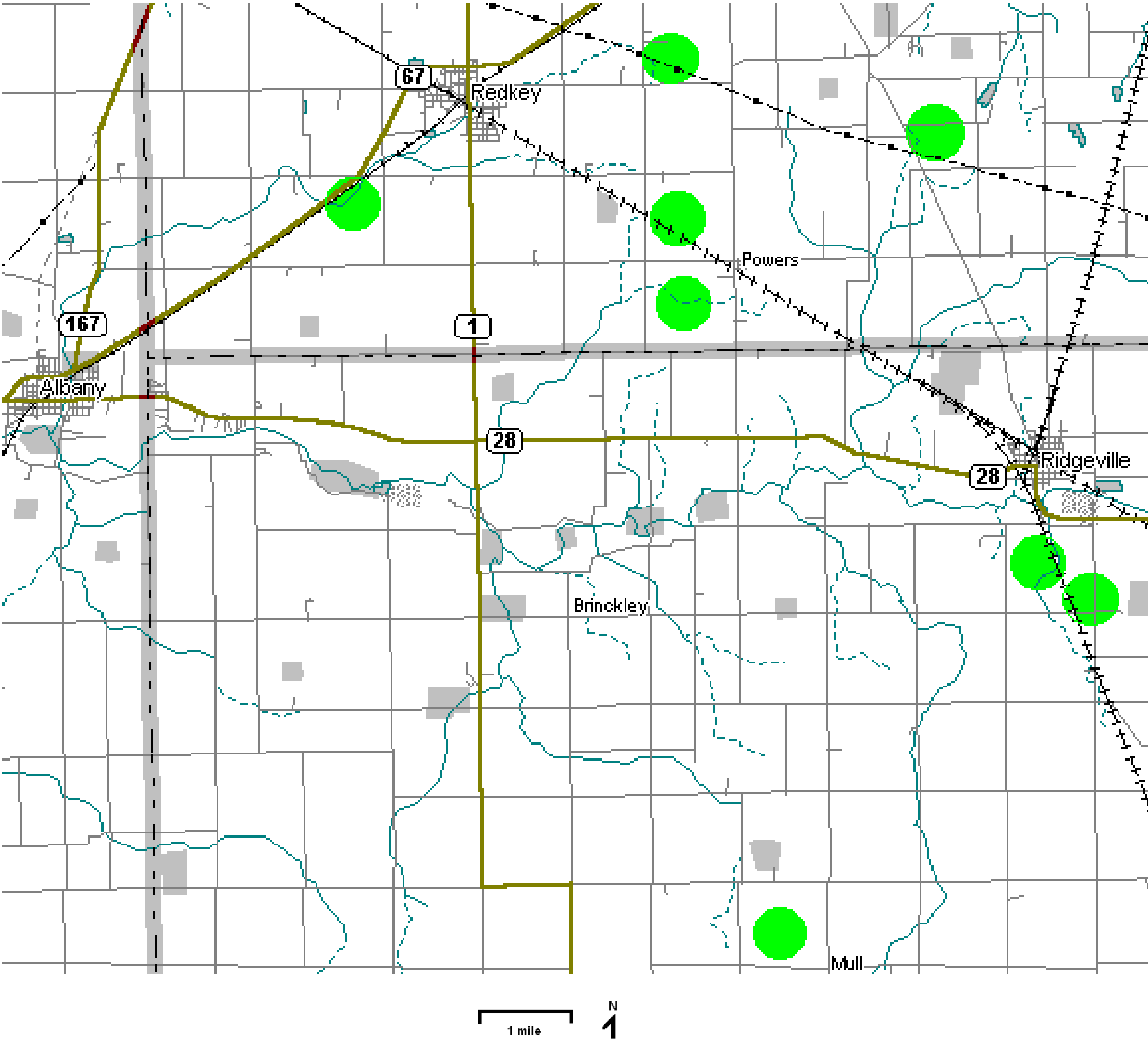


Fig. 4. Chemical analysis trends for IDEM data

IDEM, Office of Land Quality, 2001, List of confined feeding operations [17].

There are 8 confined feeding operations with state permits in the watershed. They are identified by the green circles on the map below.

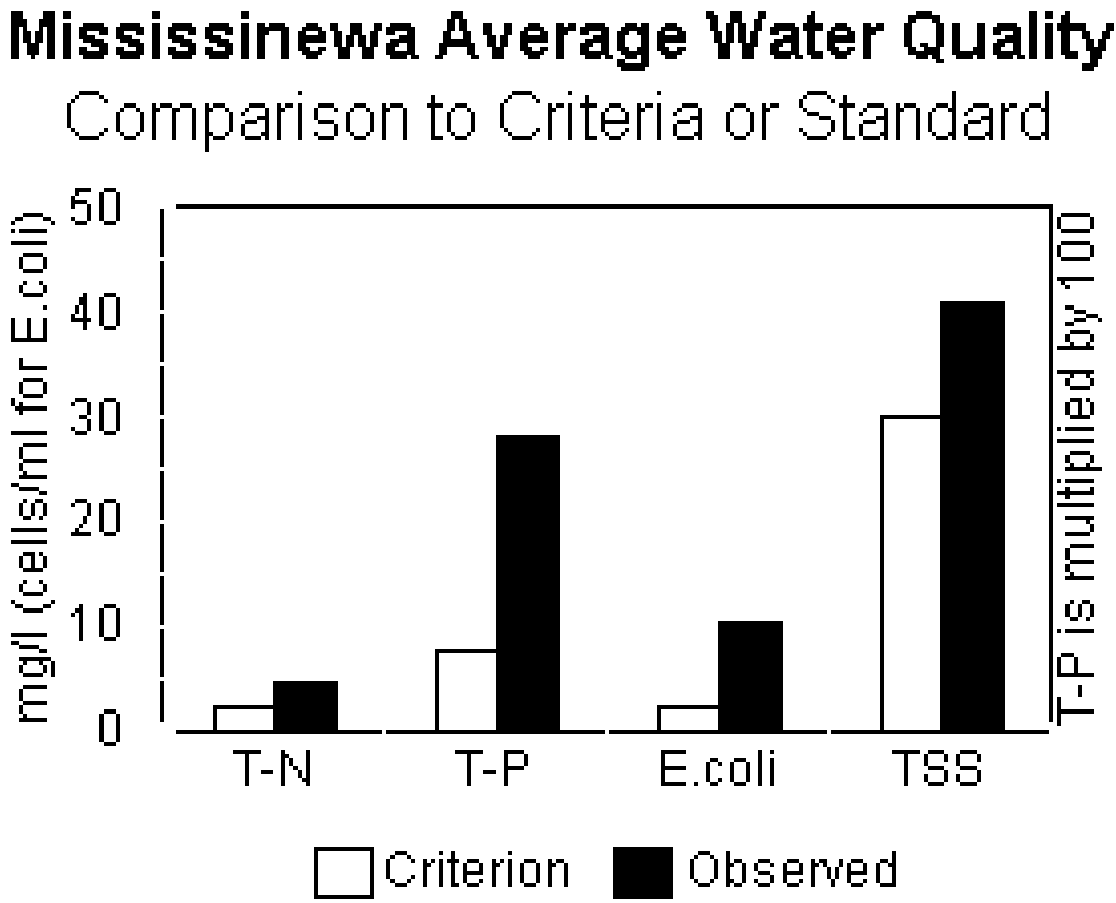
Fig. 5. Confined feeding operations in the Mississinewa River watershed.



IDEM, 1979-1995. Fixed station monitoring data for the Mississinewa River at Ridgeville. [23].

IDEM's Office of Water Quality (Surveillance and Surveys Section) collects and analyzes water samples every month from the Mississinewa River at Ridgeville. The data show the following trends:

	Average	Noteworthy?
TKN-Nitrogen:	0.7 mg/l	No problem
Nitrate-Nitrogen:	3.9 mg/l	Exceeds draft criterion [25]
Ammonia-Nitrogen:	0.1 mg/l	No problem
Total Phosphorus:	0.28	Exceeds draft criterion [25]
Suspended Solids	41 mg/l	Higher than usual [20]
Dissolved oxygen:	9.6 mg/l	No problem
E. coli	1026/100 ml	Exceeds WQ standard [26]



B. SUMMARY OF AVAILABLE INFORMATION

Total drainage area of this hydrologic unit of the Mississinewa River is 134 square miles. The five largest sub-watersheds are Days Creek, Bush Creek, Halfway Creek, Bear Creek, and Mud Creek. Many of the tributaries of the Mississinewa River in this watershed have been artificially straightened and are presently classified as "legal drains." They are under the authority of the County Surveyor, who is legally mandated to maintain their channels to promote drainage.

About 90% of the watershed is devoted to row-crop agriculture. Livestock production is higher than the state average, especially for hogs and sheep. There are 8 confined feeding operations in the watershed.

Water quality information has been collected regularly at one site. This section of the Mississinewa River is considered "impaired" due to high levels of mercury and PCBs in fish. Water samples regularly exceed the draft nutrient criteria for phosphorus and nitrogen. Suspended solids concentrations are higher than most other Indiana agricultural streams and the E.coli bacteria levels frequently exceed the Indiana water quality standard for recreational uses. Despite these indicators of water quality problems, the fish community of the river is indicative of an ecologically healthy stream and freshwater mussels are present. The biological community of the river appears to be in good condition, but improvements in water quality would serve to protect and enhance this important natural resource. There is evidence from the long-term monitoring done in this watershed that at least some of the water quality conditions have improved over the past decade.

There is only one rare or threatened species known from the watershed, although several additional species are know from nearby watersheds. The Davis-Purdue forest along Elkhorn Creek in the Bush Creek watershed is a somewhat protected "natural area," featuring many large native trees. The McVey Memorial Forest in the Bush Creek watershed along Highway 1 and the parcels of land in the Wilbur Wright Fish and Wildlife Area along Heuss Ditch are also important protected natural areas. The lower end of Bush Creek is known to support a rare wetland plant (orange coneflower). The fish community of the Mississinewa River is very diverse and pollution intolerant fish species are present.

According to U.S.EPA, the Mississinewa River watershed has high vulnerability for nutrient, pesticide and sediment export. Some soils in the watershed have a moderate to high potential erosion rate. There is a low density of septic tanks and a high density of livestock and "cropland pressure."

There are five wastewater dischargers in the watershed. The Town of Ridgeville has three combined sewer overflows discharging untreated sanitary and storm water during high flow periods. The Town of Albany's wastewater system has peak flows which often exceed design flows. This causes untreated sewage to frequently overflow to Halfway Creek.

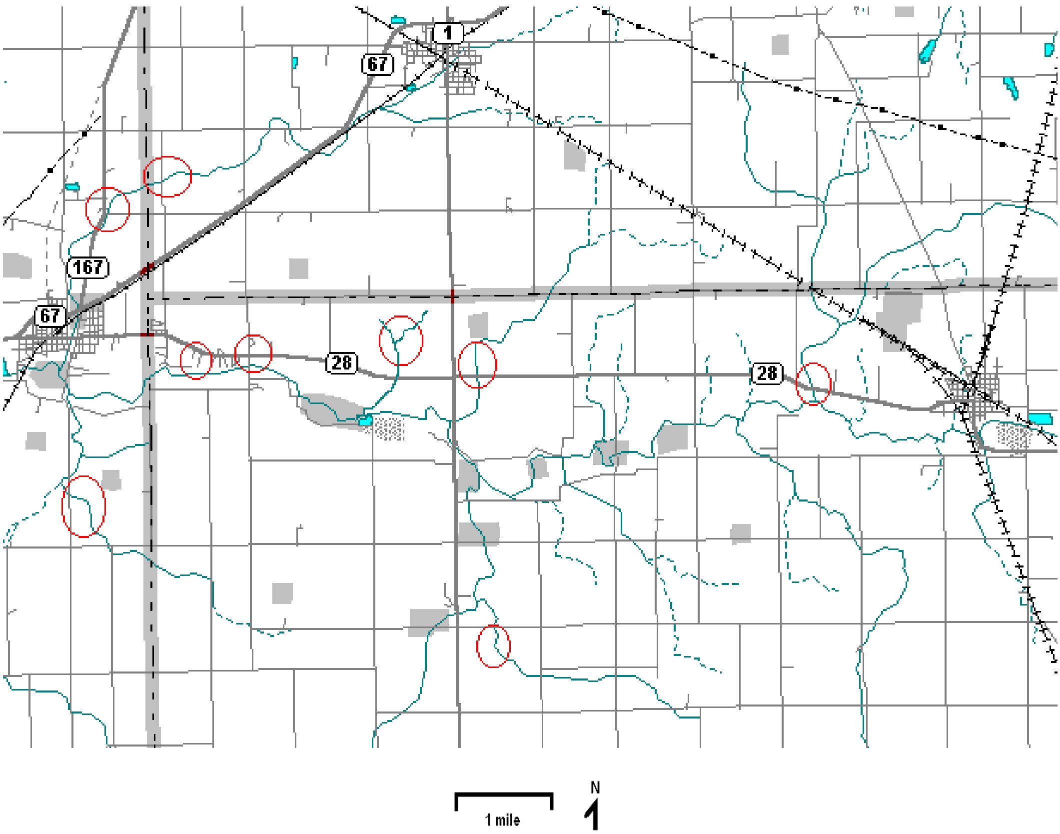
III. COLLECTION OF ADDITIONAL NECESSARY INFORMATION

WHAT ADDITIONAL INFORMATION DO WE NEED TO MAKE GOOD DECISIONS ABOUT WATER QUALITY MANAGEMENT IN THIS WATERSHED?

A. WATERCOURSES ON STEEP SLOPES

Portions of streams which flow through areas of steep slopes on soils which are vulnerable to erosion are most likely to contribute to excessive sediment loading. Therefore, it is important to identify areas within a watershed on steep slopes. Digital elevation maps (DEMs) produced by the U.S.Geological Survey are useful for this type of analysis. A DEM was used to locate stream segments flowing directly through areas with slopes greater than 10% highlighted. These sites are shown as red circles in Fig. 6.

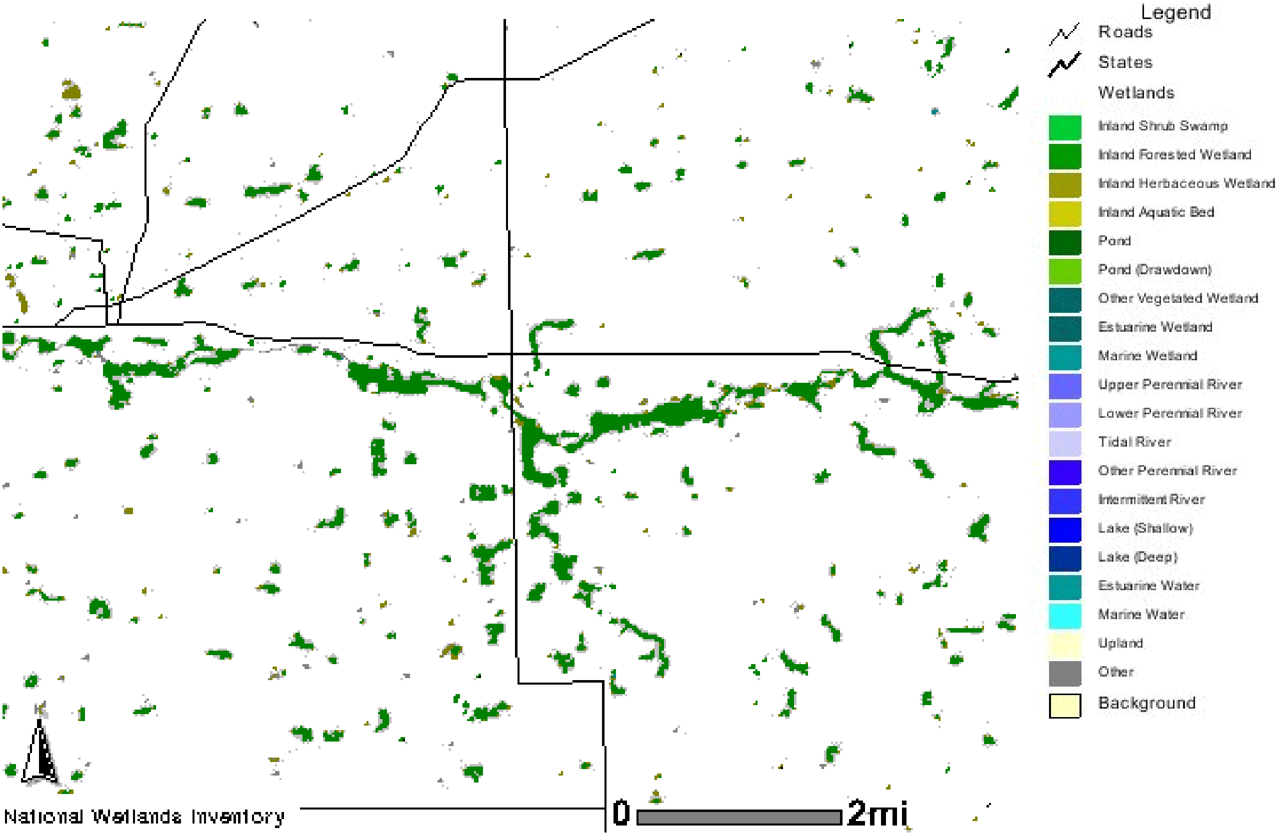
Fig. 6. Stream segments with high erosion potential



B. WETLANDS

There are numerous wetlands in the watershed. A map of wetlands based on the National Wetland Inventory maps is shown in Figure 7. Most of these are forested and exist along waterways. These wetlands have a high potential for sediment and nutrient filtration. Some wetlands in this map have been severely drained for agriculture but could be restored at relatively low cost to assist with sediment and nutrient control. This option is discussed in more detail in Section V.

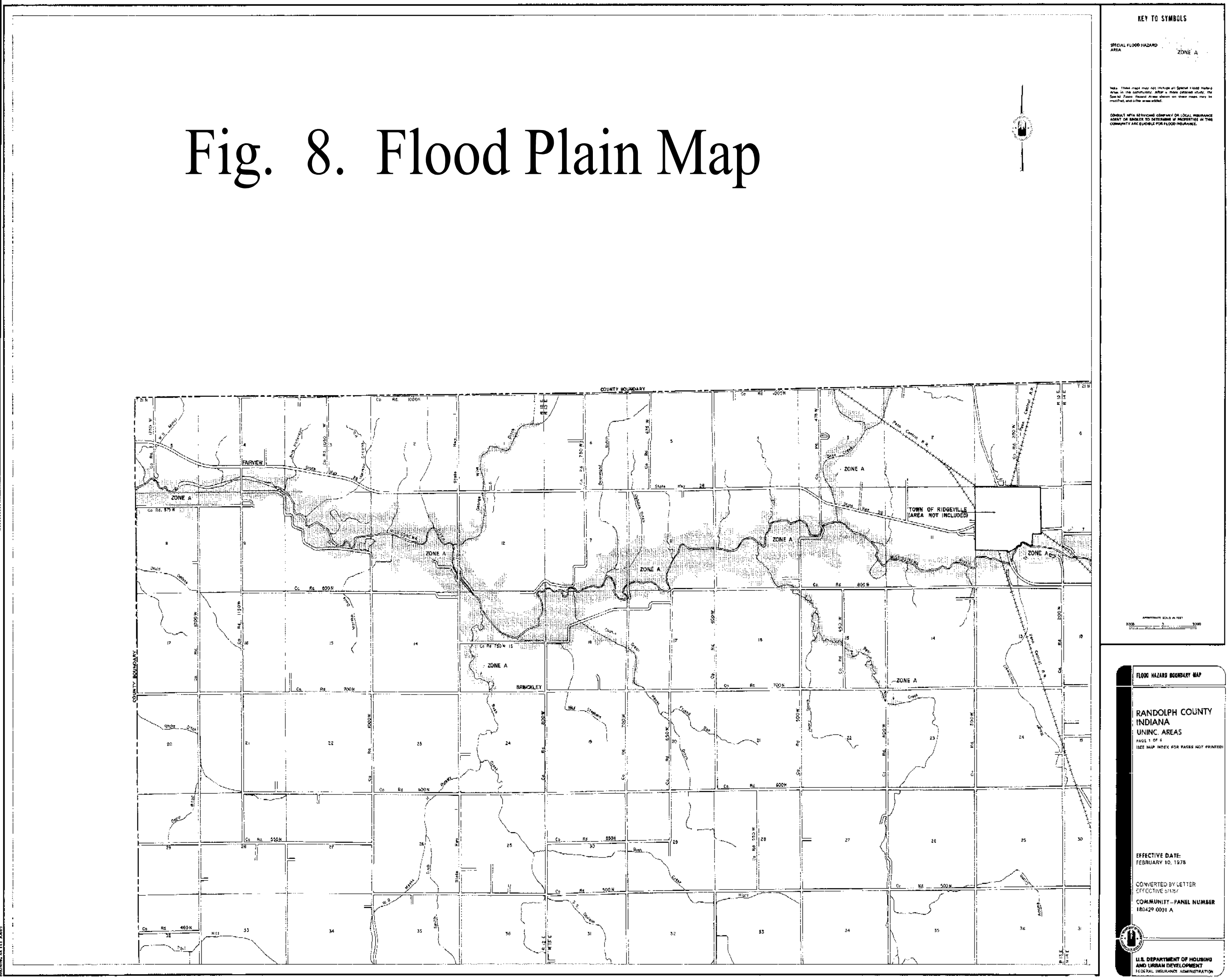
Fig. 7. Location of major wetlands in the watershed



C. FLOOD PLAINS

Flood plains in the watershed have been mapped by the Federal Emergency Management Agency and are shown in Fig. 8. Many of the wetland areas shown in Figure 7 are in the Mississinewa River flood plain, which extends up to 2000 feet on either side of the river in many areas. “High Water” warning signs are common along county roads bordering the river. Knowledge of the location of flood plains is necessary if a construction permit is needed for installation of certain best management practices.

Fig. 8. Flood Plain Map



D. CHEMICAL AND BIOLOGICAL SAMPLING

Chemical and biological sampling within the watershed was conducted to provide a diagnosis of what kinds of water quality problems exist and how severe they are. Chemical sampling provides a “snapshot” of conditions as they exist when the water sample is collected. In contrast,, biological sampling provides a “movie” of water quality at the site. This is because animals that live in the water are exposed to conditions there continuously.

Chemical sampling included the following parameters, collected once during base flow and once during storm flow conditions:

	Indicator Value
Dissolved Oxygen	Oxygen must be present above 5 mg/l for most aquatic life
pH	pH above 8 indicates the potential for excessive algal growth
Conductivity	A quick measure of total dissolved solids present in the water
Temperature	Temperatures above 30 degrees C hurt most aquatic life
Ammonia	A nutrient that also can be toxic to aquatic life
Nitrate	A nutrient that accelerates algal growth
Phosphorus	A nutrient that accelerates algal growth
Chlorophyl a	Tells how much algae is present in the water column
Turbidity	Too much turbidity reduces light and clogs gills of animals
E. coli	Bacteria that indicates possible health hazard for swimming

Biological sampling was done one time during the summer at 13 sites (see below). This technique resulted in two measurements:

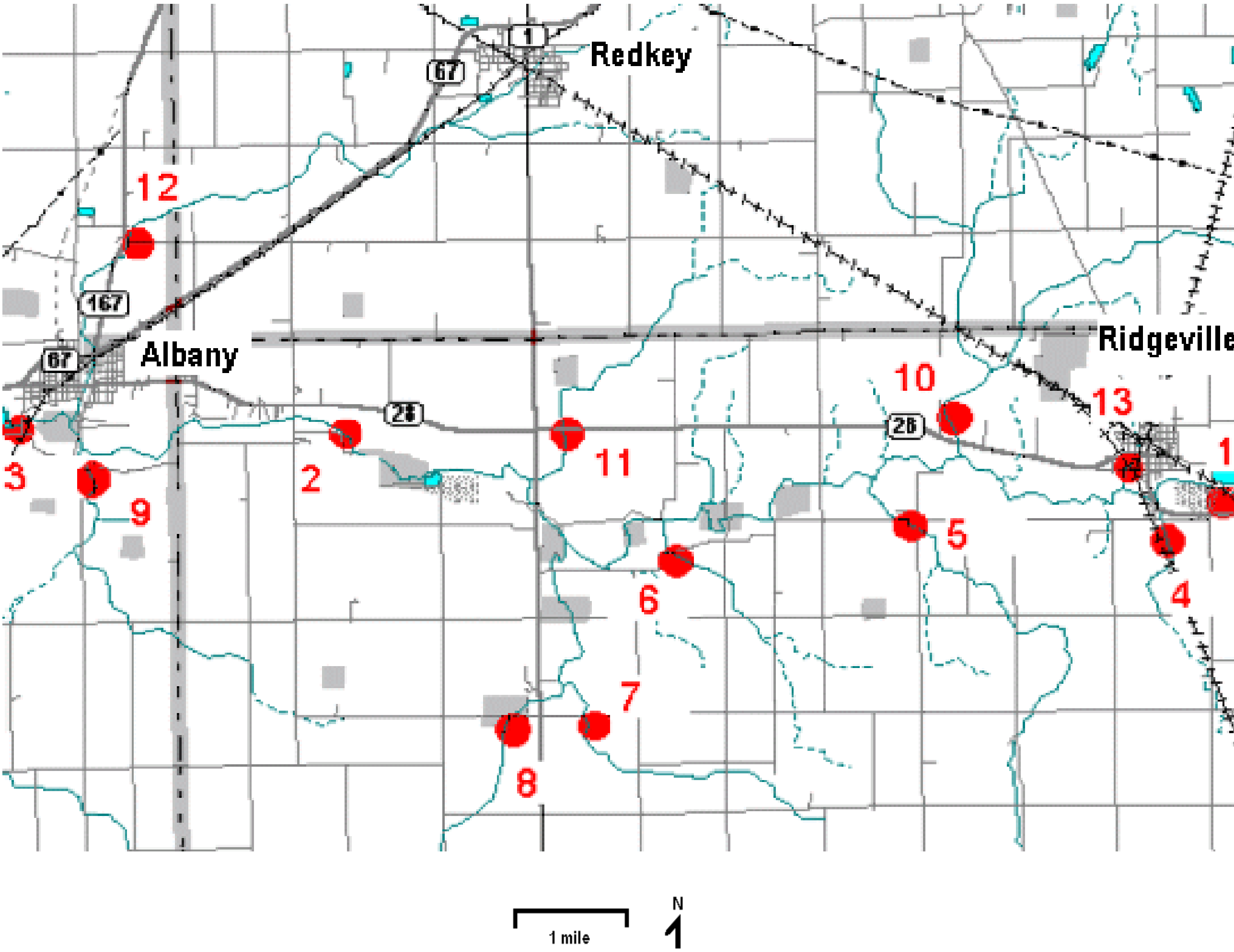
The index of biotic integrity (IBI)
  A score that ranges from 0 (indicator of a life-less stream)
  to 100 (the healthiest possible stream for this part of the country).
The qualitative habitat evaluation index (QHEI)
  A score that ranges from 0 (a dry, formless stream)
  to 100 (the best possible habitat for this part of the country).

Both the IBI and QHEI provide scores that allow one site to be compared with others and provide a system for prioritizing problems.

Thirteen sampling sites near the mouth of each of the major tributaries were chosen for this study (see Fig. 9). One site was a nearby “reference site” know to have relatively good water quality, aquatic habitat, and fish communities. The reference site is used to provide a basis for comparison to the study sites. Watershed areas of each site [1] and their locations are shown below:

Site	Description	Drainage Area	Latitude	Longitude
Site 1	Mississinewa River CR 100 W	340 km^2 (133 mi^2)	40.16.81	84.59.67
Site 2	Mississinewa River CR 850 N	558 km^2 (218 mi^2)	40.17.30	85.11.13
Site 3	Mississinewa River Dowden Road	684 km^2 (267 mi^2)	40.17.67	85.14.92
Site 4	Fetid Creek CR 800 N	10 km^2 (4 mi^2)	40.16.77	85.01.61
Site 5	Bear Creek CR 800 N	41 km^2 (16 mi^2)	40.16.77	85.04.53
Site 6	Heuss Ditch CR 750 N	12 km^2 (5 mi^2)	40.16.50	85.07.36
Site 7	Bush Creek CR 600 N	25 km^2 (10 mi^2)	40.15.00	85.08.34
Site 8	Elkhorn Creek CR 600 N	20 km^2 (8 mi^2)	40.15.00	85.09.13
Site 9	Mud Creek CR 670 N	18 km^2 (7 mi^2)	40.17.25	85.14.16
Site 10	Days Creek Highway 28	44 km^2 (17 mi^2)	40.17.48	85.04.00
Site 11	Platt Nibarger Ditch Highway 28	15 km^2 (6 mi^2)	40.17.64	85.08.60
Site 12	Halfway Creek Highway 167	56 km^2 (22 mi^2)	40.19.27	85.13.69
Site 13	Ridge Run Ridgeville	6 km^2 (2 mi^2)	40.16.66	85.02.19
Reference Site	Stoney Creek Windsor Pike	115 km^2 (45 mi^2)	40.09.41	85.12.54

Figure 9
Study Sites - Mississinewa Watershed



METHODS

Water Chemistry

Water chemistry measurements were made at each study site on the same day that macroinvertebrate samples were collected. Dissolved oxygen was measured by the membrane electrode method. The pH measurements were made with a Cole-Parmer pH probe. Conductivity was measured with a Hanna Instruments meter. Temperature was measured with a mercury thermometer. All instruments were calibrated in the field prior to measurements.

Samples for nutrient and bacteria analysis were collected as grabs and returned to the lab for analysis using methods approved by the APHA. E. coli were measured by the membrane filtration method, using m-coliblue as the growth medium. Nitrate and phosphorus were measured by spectrophotometry. Ammonia was measured by the ion-specific probe method. Data sheets are attached in an appendix.

Biological Communities

Because they are considered to be more sensitive to local conditions and respond relatively rapidly to environmental change, benthic (bottom-dwelling) organisms were used to document the biological condition of each stream. The U.S. Environmental Protection Agency (EPA) has recently developed a "rapid bioassessment" protocol [7] which has been shown to produce highly reproducible results that accurately reflect changes in water quality. We used EPA's Protocol III to conduct this study. Protocol III requires a standardized collection technique, a standardized subsampling technique, and identification of at least 100 animals from each site to the genus or species level from both "study sites" and a "reference site." CPOM (Coarse Particulate Organic Matter) samples were collected and analyzed to determine the percentage of shredder organisms.

Reference Site

The aquatic community of a reference site is compared to that of each study site to determine how much impact has occurred. The reference site should be in the same "ecoregion" as the study sites and be approximately the same size. It should be as pristine as possible, representing the best conditions possible for that area.

Previous studies of the aquatic community of the Stoney Creek watershed [5] found that this stream in Delaware and Randolph County had one of the best fish communities and habitat values in the area. Since this stream is in the same geographic area as the Mississinewa River and is roughly the same size, Stoney Creek makes an ideal reference stream.

Habitat Analysis

Habitat analysis was conducted according to Ohio EPA methods [24]. In this technique, various characteristics of a stream and its watershed are assigned numeric values. All assigned values are added together to obtain a "Qualitative Habitat Evaluation Index." The highest value possible with this habitat assessment technique is 100.

Macroinvertebrate Sample Collection

Benthic samples in this study were collected by the “kick net” method from riffles. The samples were preserved in the field with 70% isopropanol and returned to the lab for analysis.

Laboratory Analysis

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the whole sample in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species). As each new taxon was identified a representative specimen was preserved as a "voucher." All voucher specimens have been deposited in the Purdue University Department of Entomology collection.

RESULTS

Water Quality Measurements

Water chemistry results collected during dry weather are shown in Table 1. Data collected in wet weather are shown in Table 2. Some additional sample collected during dry weather are shown in Table 3.

Table 1. Water Quality (Base Flow) May 29, 2003

Site	D.O. mg/l	pH SU	Cond uS	Temp C	ChlA ug/l	Turb NTU	NO3 mg/l	NH3 mg/l	PO4 mg/l Total	PO4 mg/l Ortho	E.coli /100 ml
Mississinewa Site 1	9.0	8.3	680	18.0	29	4.8	15.0	<0.1	0.22	0.14	125
Mississinewa Site 2	9.9	8.6	620	20.5	45	5.2	10.0	0.1	0.11	0.08	60
Mississinewa Site 3	8.9	8.2	660	19.5	43	7.7	13.0	0.1	0.21	0.19	398
Fetid Creek Site 4	7.4	8.1	660	19.0	27	4.8	9.7	0.1	0.27	0.21	2250
Bear Creek. Site 5	8.6	8.1	700	18.5	33	4.3	5.0	0.1	0.19	0.14	89
Heuss Ditch Site 6	8.8	8.2	700	19.0	33	4.2	9.0	0.1	0.20	0.14	25
Bush Creek Site 7	9.0	8.1	700	21.0	32	4.3	2.1	0.1	0.23	0.18	443
Elkhorn Creek Site 8	8.8	8.0	700	19.5	27	3.3	7.5	0.1	0.25	0.21	428
Mud Creek Site 9	8.8	8.0	700	20.5	20	4.3	6.5	0.1	0.17	0.13	72
Days Creek . Site 10	9.1	8.3	700	21.0	20	3.8	11.0	0.1	0.15	0.13	156
Platt Nibarger Site 11	9.2	8.3	700	22.0	41	13.7	15.0	0.1	0.33	0.28	3
Halfway Cr. Site 12	9.7	8.4	700	23.0	30	5.1	9.5	0.1	0.40	0.35	58
Ridge Run Site 13	9.5	8.2	700	22.5	39	4.7	2.8	0.1	0.35	0.28	331

D.O. = Dissolved Oxygen
Turb. = Turbidity
Cond. = Conductivity
NO3 = Nitrite + nitrate (as Nitrogen)
ChlA = Chlorophyl a
NH3 = Ammonia (as Nitrogen)
PO4 = Phosphate (as Phosphorus)

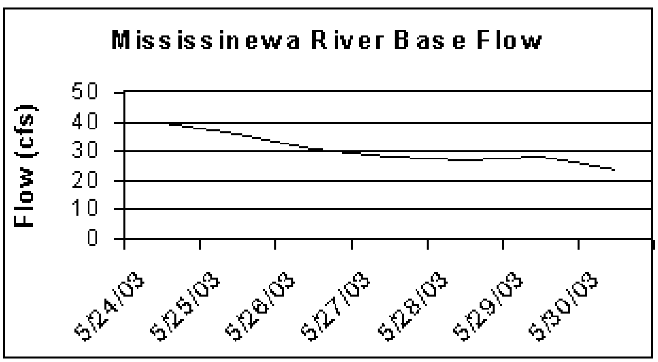
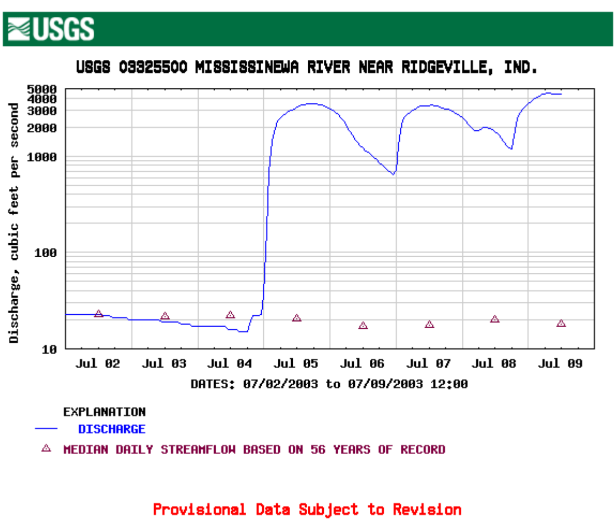


Table 2. Water Quality (Storm Flow) - July 5, 2003

Site	D.O. mg/l	pH SU	Cond uS	Temp C	ChlA ug/l	Turb NTU	NO3 mg/l	NH3 mg/l	PO4 mg/l Total	PO4 mg/l Ortho	E.coli /100 ml
Mississinewa Site 1	6.0	7.3	420	20.2	191	248	5.0	0.2	0.20	0.14	1720
Mississinewa Site 2	6.1	7.2	300	20.2	207	378	12.0	0.2	0.61	0.55	1580
Mississinewa Site 3	6.6	7.1	340	20.2	214	368	8.5	0.3	0.48	0.42	3640
Fetid Creek Site 4	6.6	7.2	300	21.3	183	232	4.0	0.4	0.69	0.65	2440
Bear Creek. Site 5	7.3	7.1	280	22.5	180	224	2.8	0.2	0.60	0.53	2960
Heuss Ditch Site 6	6.7	7.2	210	20.9	221	325	2.1	0.3	0.52	0.48	2720
Bush Creek Site 7	6.9	7.1	270	20.3	224	315	7.0	0.3	0.45	0.39	1280
Elkhorn Creek Site 8	6.8	7.2	360	20.3	168	164	17.0	0.3	0.60	0.55	5700
Mud Creek Site 9	6.4	7.2	270	20.2	144	132	8.5	0.3	0.75	0.68	480
Days Creek . Site 10	6.1	7.3	360	21.3	169	210	8.5	0.3	0.62	0.52	240
Platt Nibarger Site 11	6.7	7.3	360	21.8	164	136	14.0	0.5	0.61	0.50	2080
Halfway Cr. Site 12	5.9	7.4	380	21.3	166	176	21.0	0.5	0.42	0.39	6180
Ridge Run Site 13	7.0	7.2	270	22.8	176	236	2.5	<0.1	0.40	0.30	5340
Stoney Creek Reference	7.1	7.3	310	21.6	127	56	10.0	0.2	0.82	0.75	5400



D.O. = Dissolved Oxygen
Turb. = Turbidity
Cond. = Conductivity
NO3 = Nitrite + nitrate (as Nitrogen)
ChlA = Chlorophyl a
NH3 = Ammonia (as Nitrogen)
PO4 = Phosphate (as Phosphorus)

Table 3. Additional Water Chemistry Data

Base Flow

Site	D.O. mg/l	pH SU	Cond uS	Temp C	Date	Time
Mississinewa Site 1	9.7	8.2	760	20.5	7/29	1500
Mississinewa Site 2	15.5	8.4	730	22.0	7/30	1130
Mississinewa Site 3	8.7	8.1	730	21.5	7/30	1030
Fetid Creek Site 4	14.0	8.5	780	23.0	7/29	1415
Bear Creek. Site 5	12.1	8.2	740	24.0	7/30	1500
Heuss Ditch Site 6	12.6	7.9	790	25.5	7/30	1430
Bush Creek Site 7	17.6	8.1	800	24.5	7/30	1400
Elkhorn Creek Site 8	8.3	7.9	780	19.5	7/30	1300
Mud Creek Site 9	7.4	8.0	700	19.5	7/29	1100
Days Creek . Site 10	9.1	7.9	650	20.5	7/29	1345
Platt Nibarger Site 11	10.3	7.9	710	19.5	7/29	1300
Halfway Cr. Site 12	9.5	7.8	670	22.5	7/29	1230
Stoney Cr. Reference	9.0	7.8	660	19.0	7/29	1000

Storm Flow - Sampled by Michael Miller and Robert Canan (local volunteers)

Site	E.coli MPN/100 ml	NO3 mg/l	PO4 mg/l	Date	Time
Mississinewa Downstream Albany	100	1.3	0.45	11/2	1500
Acid Creek Albany	23	0.4	0.46	11/2	1130
Mississinewa Upstream Albany	12	1.3	0.10	11/2	1030
Halfway Creek Albany Park	750	2.5	1.0	11/2	1600
Halfway Creek Hwy 67	25	0.7	0.56	11/2	1600
Mississinewa Granville Pike	100	1.0	0.27	11/2	1500
Mississinewa Upstream Albany	16	1.2	0.38	11/2	1130
Mississinewa CR 1100 W	14	1.1	0.32	11/2	1030
Mississinewa Hwy 1	30	1.0	0.46	11/2	1130
Mississinewa CR 1250 W	900	1.3	0.24	11/2	1030

Aquatic Habitat Analysis

Aquatic habitat (QHEI) values for each site are shown in Table 4:

Table 4. QHEI Values for Each Site

	QHEI Score	% of Reference
Mississinewa (Site 1)	61	79
Mississinewa (Site 2)	71	92
Mississinewa (Site 3)	73	95
Fetid Creek (Site 4)	57	74
Bear Creek (Site 5)	50	64
Heuss Ditch (Site 6)	37	48
Bush Creek (Site 7)	43	56
Elkhorn Creek (Site 8)	69	90
Mud Creek (Site 9)	55	71
Days Creek (Site 10)	56	73
Platt Nibarger Ditch (Site 11)	51	66
Halfway Creek (Site 12)	35	45
Stoney Creek (Reference)	77	100

The maximum value obtainable is 100. Higher values indicate better aquatic habitat. Sites with lower habitat values normally have lower biotic index values as well. Most streams in this watershed had fair habitat. The best aquatic habitat occurred in the Mississinewa River and in Elkhorn Creek. Sites with the lowest aquatic habitat values were on Halfway Creek and Heuss Ditch. Habitat at these sites was hampered by a paucity of stable bottom substrate and instream cover, by a lack of any riparian buffer zone, and by channelization.

Fig. 10

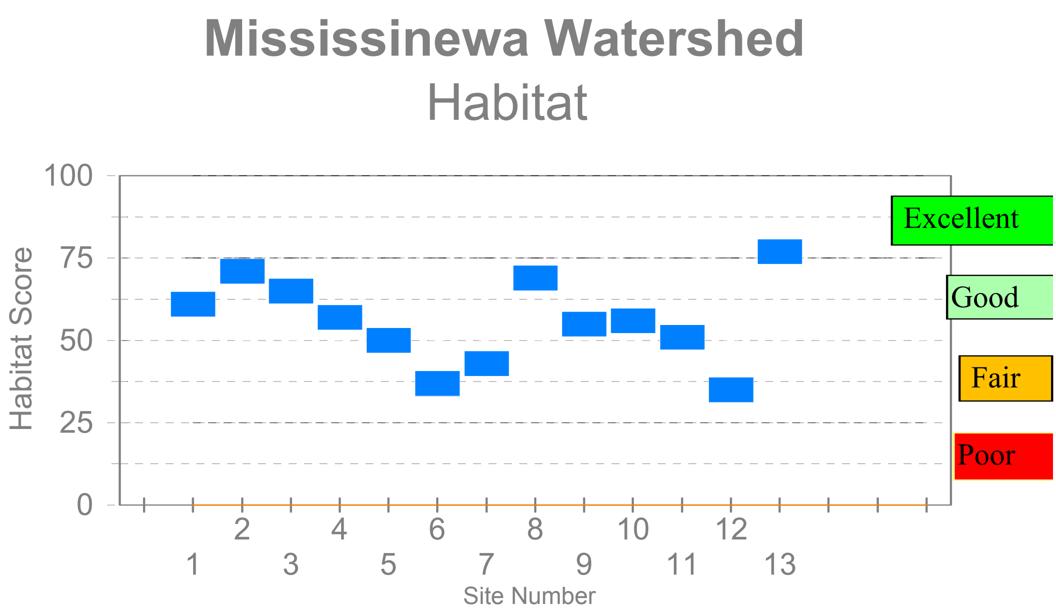


Table 5. Data Analysis for 8/03 Samples

METRICS

	Site # 1	2	3	4	5	6
# of Genera	19	18	19	12	13	13
Biotic Index	5.7	5.5	5.5	7.8	5.4	5.7
Scrapers/Filterers	2.7	1.4	1.8	0.7	1.0	0.4
EPT/Chironomids	6.2	4.9	9.8	0	5.3	6.8
% Dominant Taxon	28	19	29	40	20	41
EPT Index	7	9	9	0	7	5
Community Loss Index	0.3	0.7	0.2	0.9	0.4	0.4
% Shredders	1	0	0	0	0	1

SCORING

	Site # 1	2	3	4	5	6
# of Genera	6	6	6	4	4	4
Biotic Index	6	6	6	0	6	6
Scrapers/Filterers	6	6	6	2	6	2
EPT/Chironomids	6	6	6	0	6	6
% Dominant Taxon	4	6	4	0	6	0
EPT Index	4	6	6	0	4	2
Community Loss Index	6	4	6	4	6	6
% Shredders	2	0	0	0	0	2
TOTAL	40	40	40	10	38	28
% of Reference	83	83	83	21	79	58
Impairment Category	N	N	N	Sv	S	S

N = NONE   S = SLIGHT   M = MODERATE   Sv = SEVERE

Table 5 (continued). Data Analysis for Samples

METRICS

	Site # 7	8	9	10	11	12	13
# of Genera	11	12	10	16	9	14	15
Biotic Index	5.2	5.8	6.4	6.9	5.7	6.3	5.4
Scrapers/Filterers	0.7	2.0	1.8	10	3.8	0.4	1.5
EPT/Chironomids	3.1	0.8	1.0	1.3	2.4	1.2	5.8
% Dominant Taxon	34	27	22	28	31	35	19
EPT Index	5	5	4	6	4	5	9
Community Loss Index	0.6	0.7	0.9	0.7	1.0	0.6	0.0
% Shredders	0	0	0	0	0	0	3

SCORING

	Site # 7	8	9	10	11	12	REF
# of Genera	4	4	2	6	2	6	6
Biotic Index	6	6	4	2	6	4	6
Scrapers/Filterers	4	6	6	6	6	2	6
EPT/Chironomids	4	0	0	0	2	0	6
% Dominant Taxon	2	4	4	4	2	2	6
EPT Index	2	2	2	4	2	2	6
Community Loss Index	4	4	4	4	4	4	6
% Shredders	0	0	0	0	0	0	6
TOTAL	26	26	22	26	26	42	48
% of Reference	54	54	46	54	54	62	100
Impairment Category	S	S	M	S	S	S	N

N = NONE S = SLIGHT M = MODERATE Sv = SEVERE

RESULTS AND IDENTIFICATION OF PROBLEM AREAS

Instream chemical parameters measured at each site indicate that dissolved oxygen (D.O.), pH, temperature, and conductivity fell within acceptable ranges for most forms of aquatic life. Abundant algal growth (stimulated by high nutrient inputs) is usually indicated by pH readings significantly higher than 8.0. This was the case at all sites during the dry weather sampling but was especially true at Site 2 on the Mississinewa, Site 4 on Fetid Creek, and Site 12 on Halfway Creek. High algal growth rates are also indicated at sites where dissolved oxygen is much higher than the saturation level. This situation was observed during dry weather sampling at Sites 2, 4, 6, 7, and 11. Because algae also use oxygen when light is not present, sites with abundant algae typically have large variations in D.O. During the night or on cloudy days the D.O. at such sites may drop below the 5 mg/l minimum required for healthy aquatic communities.

Nutrient and suspended solids concentrations were relatively high compared to other streams in Indiana flowing through areas with primarily agricultural land uses [20]. Nitrogen and phosphorus concentrations were roughly 2-4 times higher than the nutrient criteria proposed for Midwestern streams [25]. *E.coli* concentrations exceeded the Indiana water quality standard for recreational uses [26] at 38% of the sites during dry weather and at 100% of the sites during wet weather.

A total of 54 macroinvertebrate genera were collected. The most commonly collected groups were midge larvae, aquatic beetles, snails, and net-spinning caddisflies. The pollution intolerant groups Ephemeroptera and Trichoptera (mayflies and caddisflies) were abundant at most sites but noticeably absent at site 4 (Fetid Creek).

Table 5 shows how the aquatic communities at the twelve study sites compared to that of the reference site. The sites with the highest biotic index and habitat value were on the Mississinewa River upstream and downstream from Albany. These site's habitat and biota are similar to that of a "reference" stream. This result shows that the Mississinewa River itself is in relatively good condition.

Some of the tributaries are impacted. Figure 11 shows the normal relationship of biotic index scores to habitat values (a linear relationship according to [7]). The figure also shows a range of plus or minus 10% to account for a certain amount of measurement variability. When biotic index values fall outside this range, the site typically has degraded water quality. Fig.11 indicates that five of the twelve study sites had biotic values outside the range expected from their measured habitat value. Therefore, these sites are impacted by both water quality and habitat degradation. The largest deviation from the expected value occurred at site 4 (Fetid Creek). Efforts to improve water quality in the watershed should be focused on the areas in Fig. 12.

Figure 11.

The normal relationship between habitat and biotic index score is shown below. Sites falling outside the normal relationship (plus or minus 10%) are probably affected by degraded water quality and are highlighted.

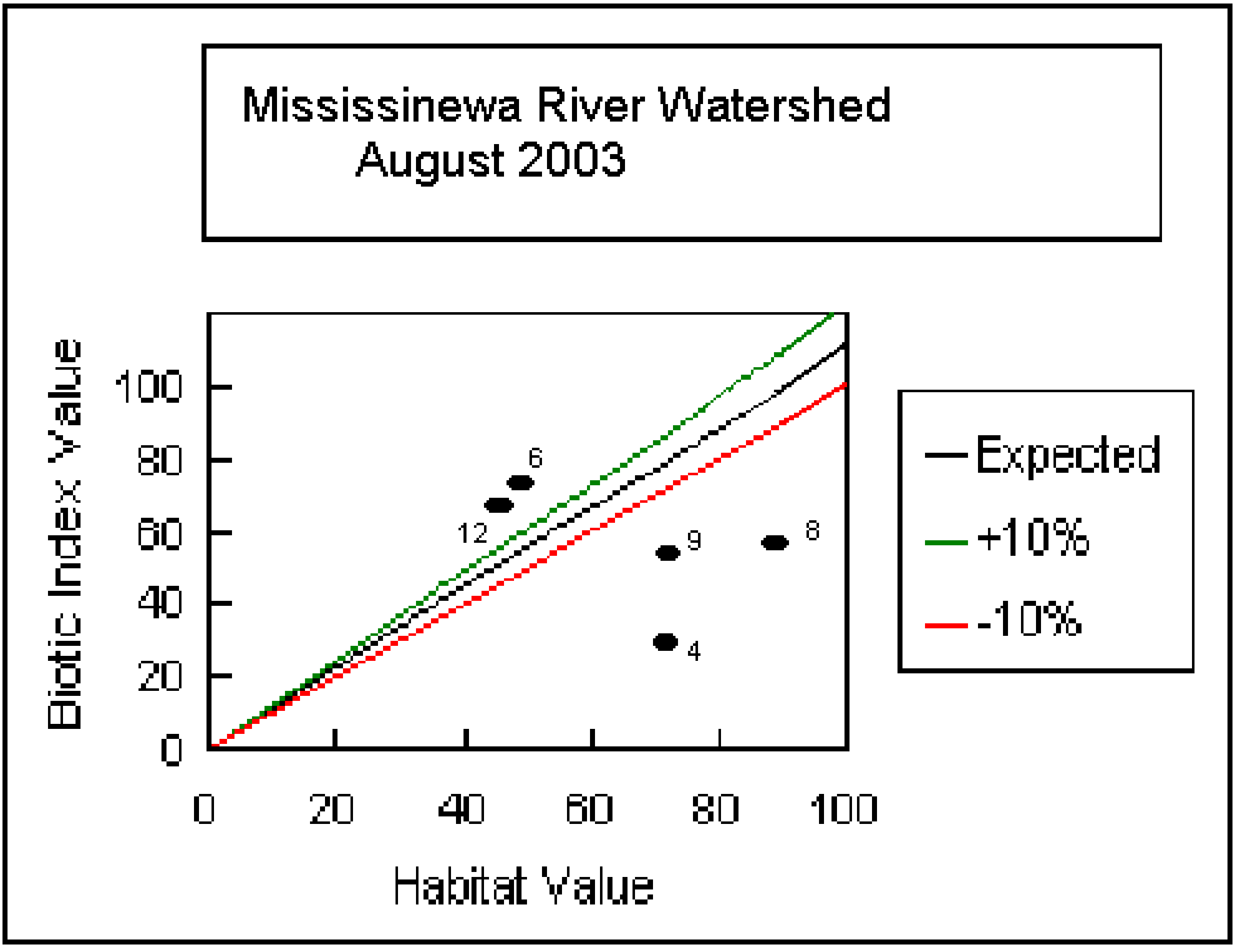
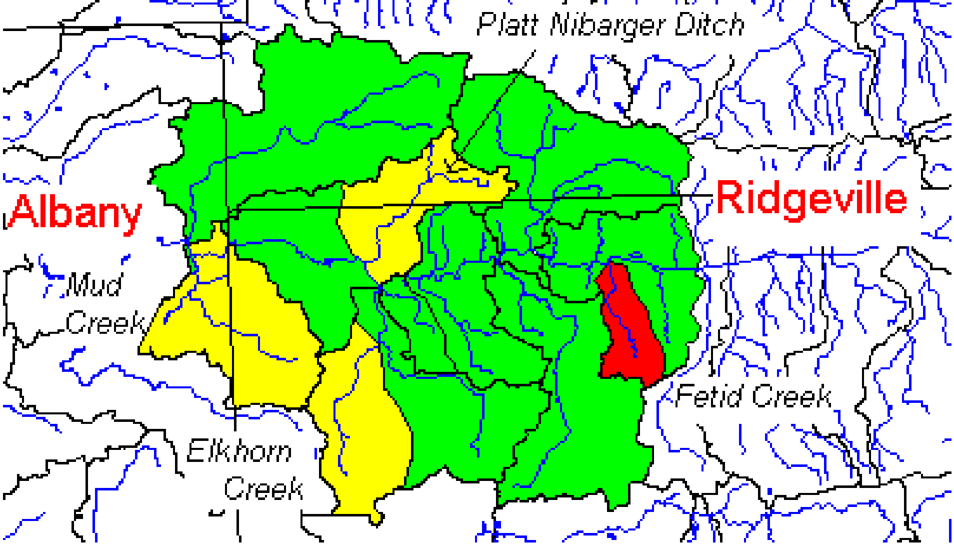
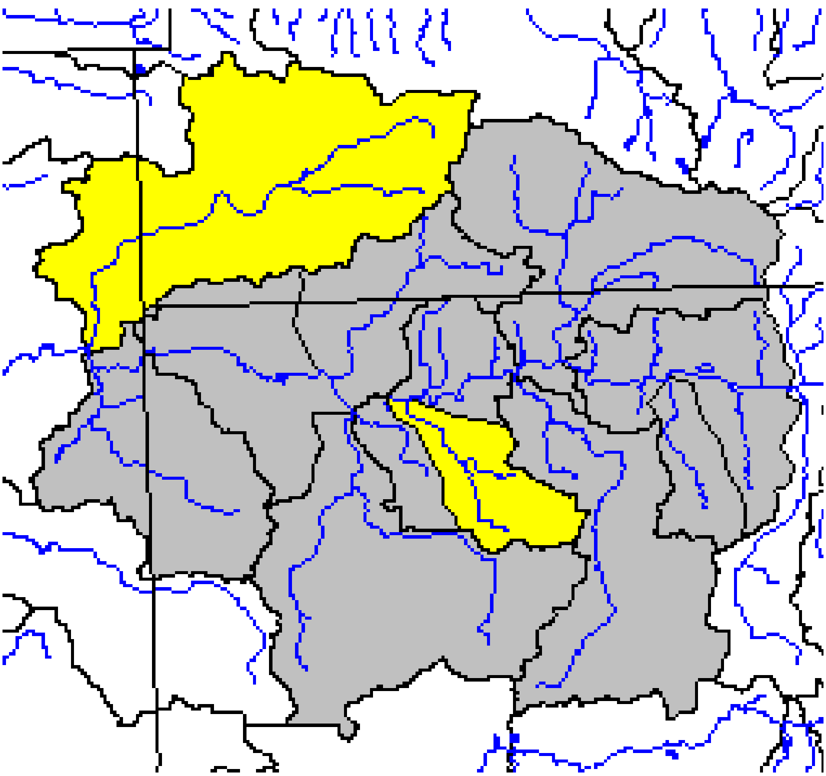


Fig. 12.

Sub-watersheds with the worst water quality





The biotic index of some streams will not improve until aquatic habitat is improved. These areas are shown in Fig. 13.

Habitat improvements include establishing shading trees, decreased channelization, and streambank stabilization.

Fig. 13

Sub-watersheds needing habitat improvements

Halfway Creek
Heuss Ditch

What kinds of water quality problems are contributing to impairment? Table 6 shows sediment-tolerance values for many of the commonly collected animals in these streams. The proportion of sediment and turbidity-intolerant forms was higher at the reference site than at most other sites. No intolerant animals were observed at 5 sites. These results indicate that sediment-related impairment may be contributing to the water quality problems in the watershed.

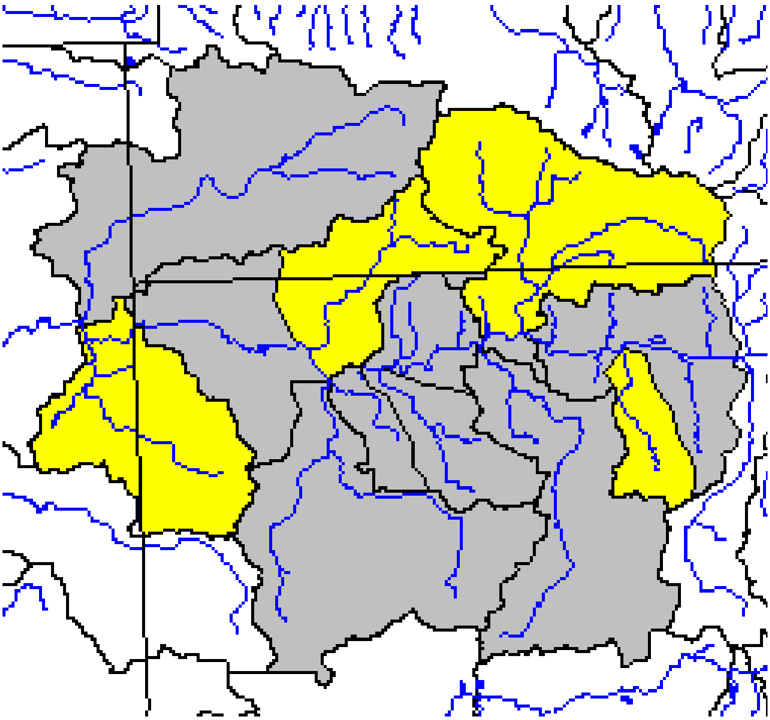
Table 6. Sediment-Intolerant Species Observed

% of Sediment-Intolerant Organisms at the Reference - 22%
% of Sediment-Intolerant Organisms at the Study Sites

Site 1	1%	Site 7	0%
Site 2	12%	Site 8	2%
Site 3	4%	Site 9	0%
Site 4	0%	Site 10	0%
Site 5	12%	Site 11	0%
Site 6	0%	Site 12	1%

Best management practices which reduce soil erosion and increase streambank stability should be used in the sub-watersheds shown in Fig. 14.

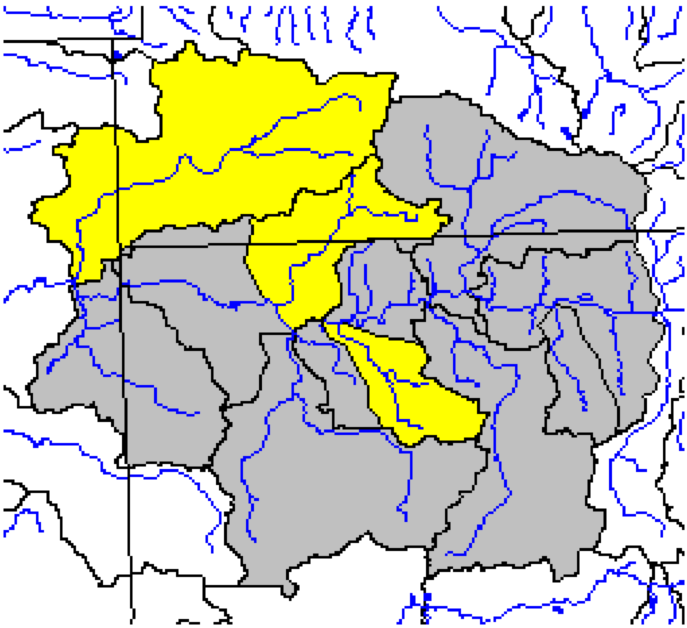
Fig. 14. Sub-watersheds affected by sediment



Fetid Creek
Days Creek
Platt Nibarger Ditch
Mud Creek

When the number of animals which eat algae attached to rocks (“scraper” organisms) become numerically dominant, excessive nutrient inputs are often the cause. Scrapers dominated at many sites. The Heuss Ditch sub-watershed is an interesting example of a stream with a biotic index much higher than its habitat value. According to [10], this type of effect also occurs where nutrient inputs are excessive. Best management practices to reduce nutrient inputs should be employed in these areas, shown in Fig. 15. Some of nutrient BMPs, such as manure storage and land application, may also bring down the high concentrations of E.coli found in Fetid Run.

Fig. 15. Sub-watersheds affected by excessive nutrient inputs



Halfway Creek
Platt Nibarger Ditch
Heuss Ditch

E.. NUTRIENT LOADING PREDICTIONS BASED ON MODELING

Computer models are sometimes useful for helping water resource managers visualize water quality and biological changes that could occur when changes in land use are made. U.S. EPA has recently released a new computer model called AQUATOX.[9] that combines water chemistry with aquatic ecology. The model allows a user to set up a model ecosystem (e.g. a stream with a given depth, length, flow, climate, and water chemistry) and observe how that ecosystem's chemistry and biology changes over time. The model also allows the user to change the ecosystem by increasing or decreasing the amount of pollutant loading that occurs. For example, the user could tell the model that Best Management Practices for agricultural land uses are going to be implemented in a watershed and that phosphorus, nitrogen, and suspended solids concentrations are going to be cut in half by these BMPs. AQUATOX tells the user how BMP implementation would affect the chemistry and biology of a stream in that watershed.

The AQUATOX model was used to predict changes in the Mississinewa River watershed that could occur with BMP implementation. The model used the following assumptions, based on actual measurements in the watershed made as part of this study:

Physical Parameters

Reach Length	16 km
Mean Depth	0.5 m
Maximum Depth	1.0 m
Surface Area	80,000 sq. m
Volume	40,000 cu. m
Temperature Range	0 - 30 degrees C
Light	361 Ly/d
Latitude	40 degrees N

Initial Chemistry (dry weather average)

Ammonia	0.1 mg/l
Nitrate	10 mg/l
Phosphate	0.3 mg/l
Oxygen	14 mg/l
TSS	30 mg/l

To measure the changes expected to occur with BMP implementation, a 50% reduction in nutrients and sediment inputs within the drainage area of the project was plugged into the model. This represents a reasonable goal for the watershed, since most best management practices commonly reduce nonpoint source pollution by more than 50%. The changes predicted by the model are shown in Figures 16 -19. The model predicts that within nine months of BMP implementation, chemical and biological improvements will begin to occur. The number of large game fish such as bass will increase by about 5-8% during summer months. Benthic biomass, especially clean water forms such as mayflies and caddisflies, will also increase in abundance. Blue-green algae, which are associated with impaired water quality, will decrease during the warmer months when they can become a problem for drinking water supplies. A second run of the model over a longer time period showed that the predicted changes will occur each year, rather than being just a one-time response.

The model was also used to predict changes in one of the watershed's tributaries. Elkhorn Creek was chosen because of its high aquatic habitat value. Because of its smaller watershed size and the fact that it lies completely within the area of BMP implementation, improvements in Elkhorn Creek are expected to be even greater than in the Mississinewa River.

Fig. 16. Annual cycle of biological changes expected during the 3 years following BMP implementation. "Bl-greens" are bluegreen algae, "D invert" are caddisflies, "H invert" are mayflies, and "Lg g fish" are bass

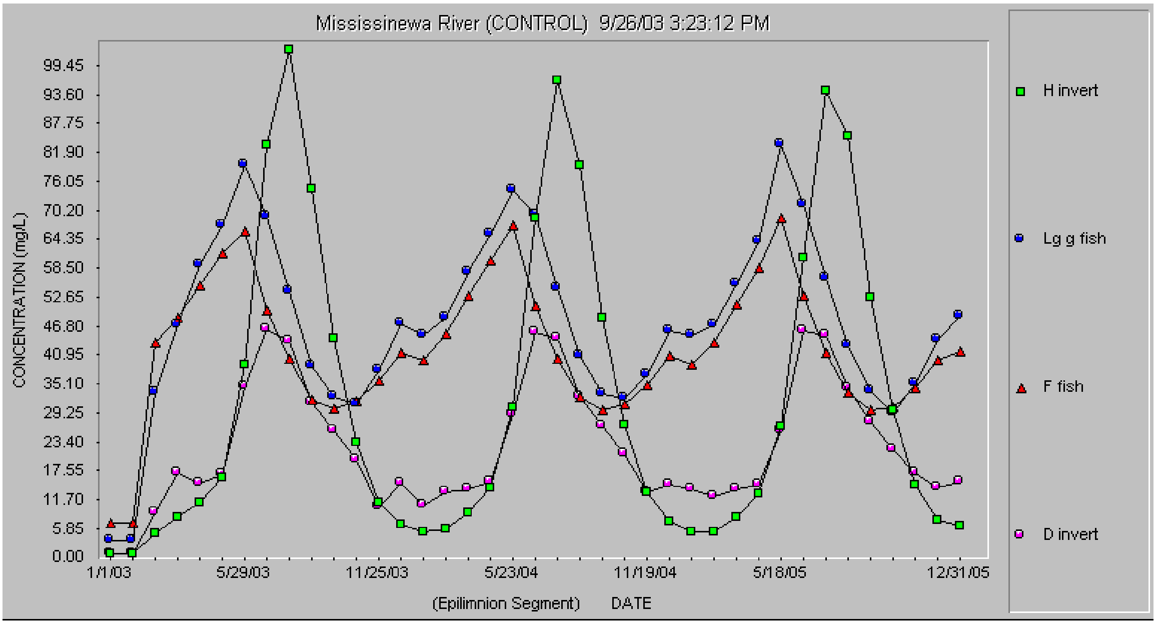


Fig. 17. Percent improvements expected during the 3 years following BMP implementation "Bl-greens" are bluegreen algae, "H invert" are mayflies, and "Lg g fish" are bass

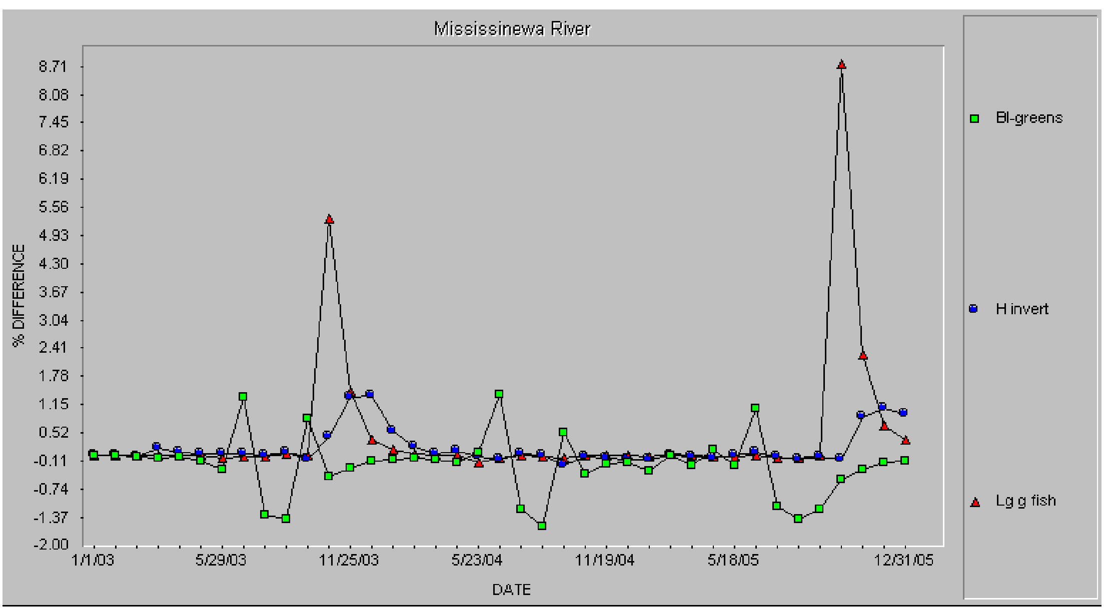


Fig. 18. Predicted changes in nutrients with BMP implementation in Elkhorn Creek

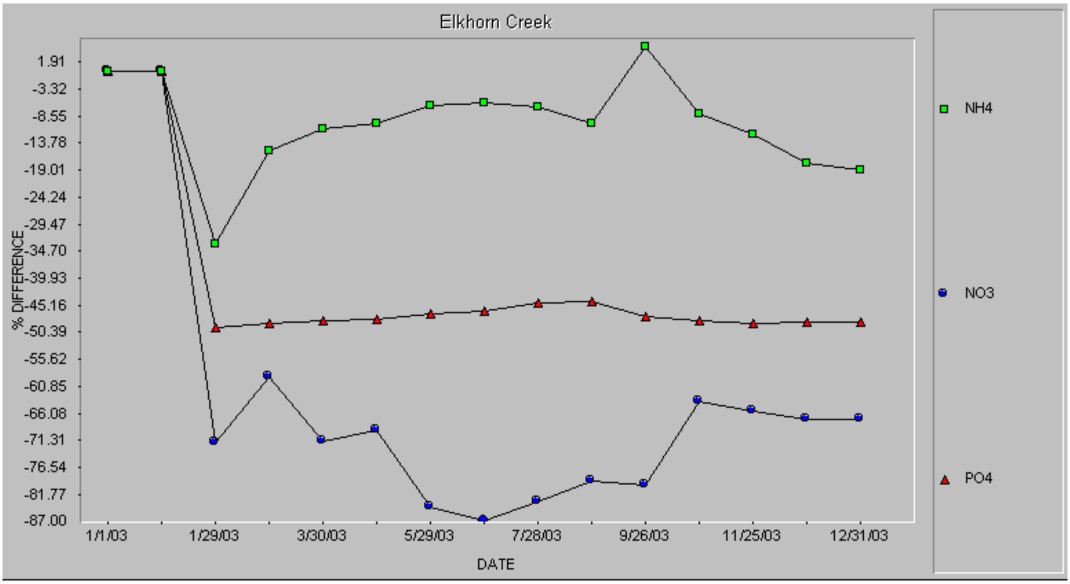
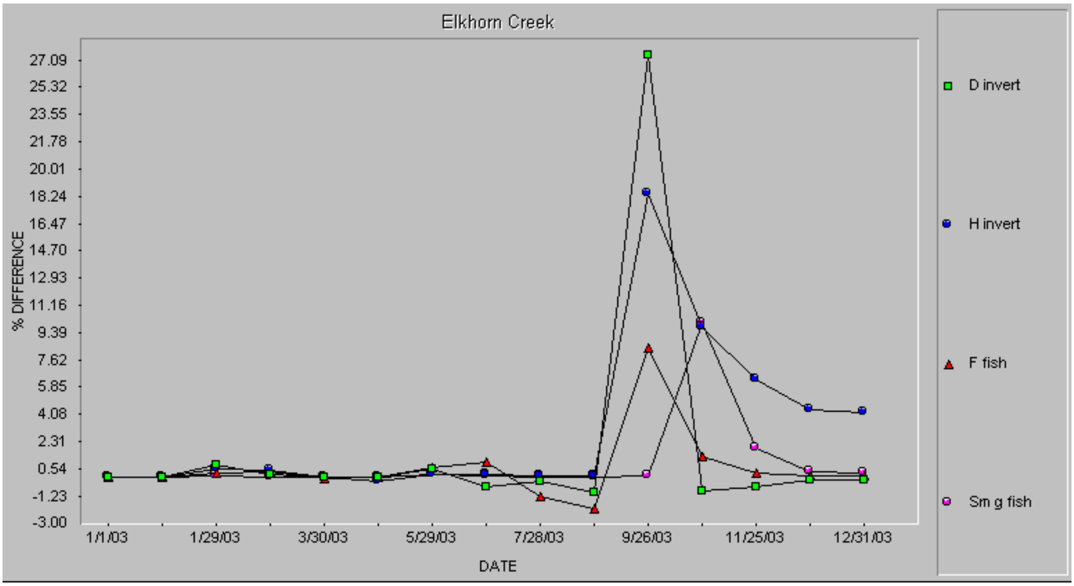
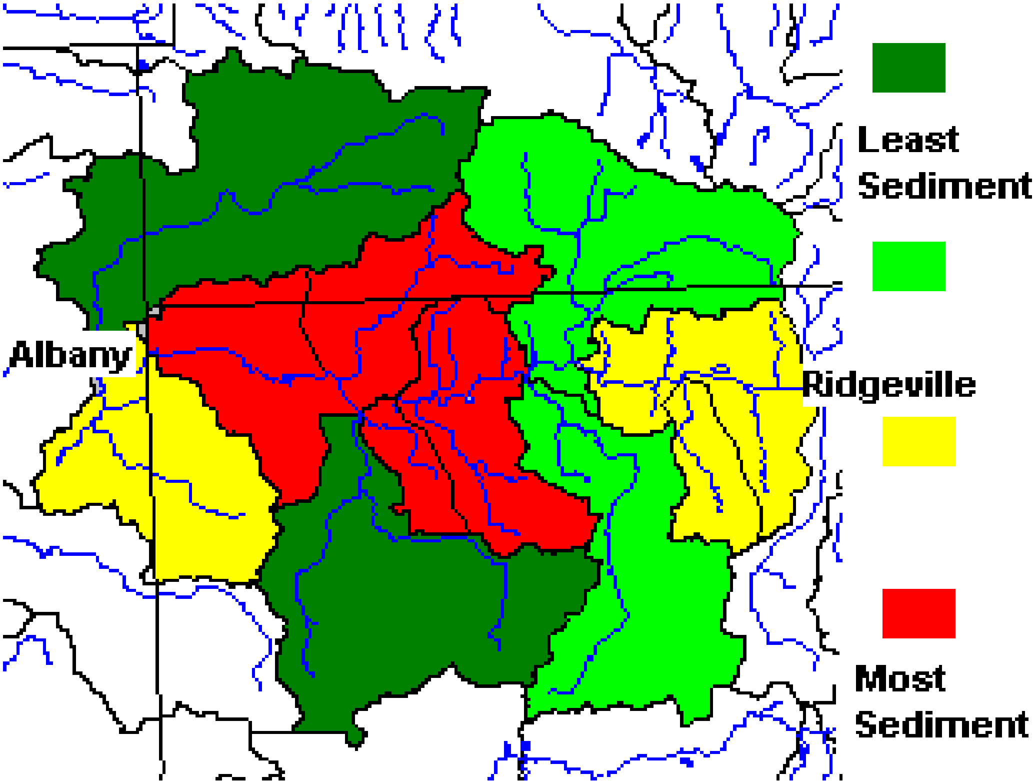


Fig. 19. Predicted changes in biology with BMP implementation in Elkhorn Creek
"D invert" are caddisflies, "H invert" are mayflies.
"F Fish" are minnows, "Sm g fish" are bluegills



During the summer of 2004, Taylor University completed a Section 319 project to model and predict sediment load in the entire Mississinewa River basin [31]. Part of this project used the Revised Universal Soil Loss Equation (RUSLE) model to predict areas where soil loss due to erosion would be predicted to be high. A map of their results for the area of the Mississinewa between Ridgeville and Albany is shown in Fig. 20.

Fig. 20. RUSLE Predictions for soil loss



It is interesting to note that the sub-watersheds predicted by the model to yield heavy sediment load (Mud Creek, Fetid Creek, and Platt Nibarger Ditch) are almost identical to those identified as having sediment-tolerant macroinvertebrates in Fig. 14. An interesting exception is Days Creek. The model predicts that Days Creek will have relatively low sediment loads, while the macroinvertebrate data found the community to be dominated by sediment-tolerant animals.

IV. SUMMARY OF PROBLEMS

	Problems	***Priority***
Fetid Creek	Sediment E.coli	High
Elkhorn Creek	Sediments	Medium
Mud Creek	Sediments	Medium
Platt Nibarger Ditch	Nutrients, Sediment	Medium
Halfway Creek	Nutrients Degraded Habitat E.coli	Low
Heuss Ditch	Nutrients Degraded Habitat	Low

V. PROPOSED SOLUTIONS

This plan proposes to reduce nutrient and sediment loading in the Mississinewa River watershed by 50%. A summary of potential BMPs is shown in Table 7. Potential sites for BMPs are shown in Fig. 20 and listed by County, Township and Section in Table 8-9.

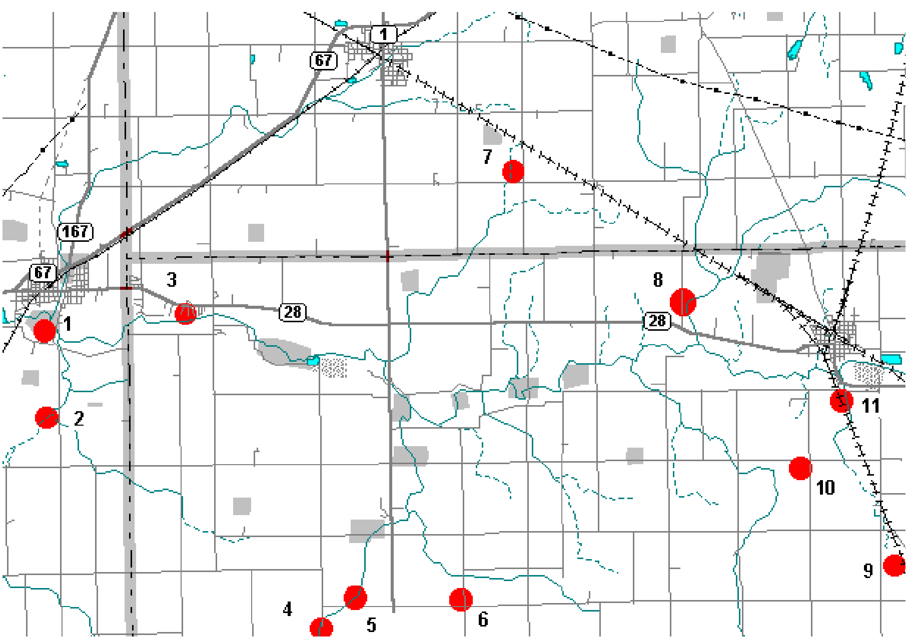


Fig. 21. Potential BMP Sites

Table 7. Summary of Proposed BMPs

Best Management Practices	***Location***
Nutrient Reduction BMPs	Fetid Creek
	Platt Nibarger Ditch
Manure Storage	Heuss Ditch
Manure Testing and Land Application	Halfway Creek
Soil Testing and Nutrient Management	
Wetland Restorations	
Sediment Reduction BMPs	Elkhorn Creek
	Mud Creek
Grade Control Structures	Fetid Creek
WASCOBs	
Streambank Stabilization	
Filter Strips	
Grassed Waterways	
Contour Buffer Strips	
Wetland Restorations	
Erosion control on steep slopes	Days Creek, Mud Creek
Livestock exclusion	Fairview Area (Site 3)
Fences to restrict access to streams	
Aquatic habitat restoration	Heuss Ditch
	Halfway Creek
Sewer rehabilitation	Halfway Creek (Albany)

Several places in the watershed have streams flowing adjacent to steep slopes with erodible soils. A photographs of one these sites is shown in Fig. 21 and the locations of additional sites are given more precisely in Table 8. These areas should be targeted for erosion-control BMPs.

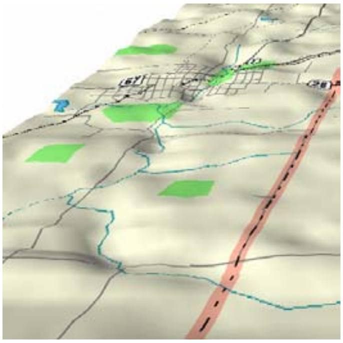
Table 8. Potential sites for erosion-control BMPs

Waterbody	***County***	***Township***	***Section***	***Site (Fig. 20)***
Elkhorn Creek	Randolph	Green	35	5
Elkhorn Creek	Randolph	Green	34	4
Bush Creek	Randolph	Green	36	6
Days Creek	Randolph	Franklin	3	8
Mud Creek	Delaware	Delaware	14	2

Several of these sites need a riparian buffer and bank stabilization to keep bank erosion from harming the stream and to keep the stream from wearing away the county roads that parallel them. Bioengineering techniques would work well in this type of situation. An example of a site (BMP site 6) where bioengineering could be applied is shown below.

Fig. 22. A potential stream bank bioengineering project site

Fig. 23. Map and photo of potential BMP sites on steep slopes near waterways.



Mud Creek topography

Steep slopes on Mud Creek

There are several sites in the watershed where livestock have direct access to streams. Livestock wear down the adjacent banks and destroy riparian vegetation as they go to the stream for water. An example of one site is shown in a photo in Fig. 22, located in Sec 5, Green Twp, Randolph County (BMP site 3 on Fig. 20). Livestock exclusion fences could be used in these areas.

Fig. 24. Livestock Exclusion Needed

Wetland restorations or enhancements would improve water quality where willing landowners would cooperate. These are especially valuable where wetlands are present immediately adjacent to a stream. Areas where such sites occur in the watershed are shown in Table 9.

Table 9. Potential sites for wetland restorations

Waterbody	***County***	***Township***	***Section***	***Site (Fig. 20)***
Fetid Creek	Randolph	Franklin	13 and 23	10 and 11
Fetid Creek	Randolph	Ward	19 and 30	9
Mississinewa	Delaware	Delaware	11	1
Platt Nibarger	Jay	Jefferson	27	7

Fig. 25. A potential wetland restoration site (BMP site 10 on Fig. 21)

Because of the relatively large number of confined feeding operations in the watershed, many tons of manure are generated. Best management practices for manure handling should be vigorously pursued. Grants for manure management are available and are discussed in more detail in Section VII.

Many tributaries in the watershed are already declared a “legal drain” so that channel maintenance (especially log jam removal and sediment dredging) can be done on a regular basis. If done without regard to best management practices, channelization can wreak havoc on the biological community of a stream. For maintaining and enhancing the quality of streams in the Mississinewa River watershed, it is important that the following minimum guidelines be applied:

> Where tree removal is necessary for equipment access, cut only on one side. This leaves one side with a row of trees to provide shade, to help keep the water cool, and to provide a source of food for stream life.
>
> Do channel maintenance in small chunks. This allows other areas to recover and minimizes the damage in the watershed.
>
> Don't dig streams out to a uniform depth. Keep shallow, swift-running areas (riffles) present. These are important places for aquatic life to grow.

VI. PRELIMINARY COST ESTIMATES OF ELEMENTS OF THE PLAN

BEST MANAGEMENT PRACTICES FOR LAND TREATMENT

The following costs are estimates based on recent expenditures by the Cass County SWCD (personal communication from Ruth Montgomery), those listed by the Noble County SWCD [11] in 1982 (doubled to provide up-to-date estimates), estimates from [12], and recent LARE grants.

Nutrient management	$50 per acre
Conservation tillage	$100 per acre
Covered manure facility	$10,000
Managed manure application	$300 per acre
Filter strip	$200 per acre + rental
Grassed waterway	$5000 per acre + rental
WASCOB	$2000
Streambank vegetation	$10 per linear foot
Sediment trap	$3 per cubic yard
Terraces	$10 per linear foot
Grade stabilization structure	$7000
Livestock exclusion	$1 per linear foot
Conservation easement	$1350 per acre for 10 year rental
Constructed wetland	$50,000 per acre
Streambank bioengineering	$ 50 per linear foot

The Indiana Department of Environmental Management, Office of Water, Watershed Branch uses a spreadsheet to predict loading reductions associated with various BMP practices [27]. Their spreadsheet model predicts an annual soil loss of 8.3 tons per acre per year before BMP implementation. However, if 10% of the watershed is enrolled in BMPs such as filter strips or conservation tillage, total soil loss per acre can be reduced by 50%.

The model also uses various published data sources to predict load reductions associated with BMPs. For example, the model predicts an average nutrient and sediment reduction of 40-70% when vegetative filter strips are installed. Using this information and the cost estimates shown above, the following costs and load reductions for BMP implementation can be predicted:

Practice	***Cost***	***Predicted Load Reduction***	
		Sediment tons/yr	***Nutrients tons/yr***
Land Treatments		6,000	15
50 Filter Strips	$ 10,000		
20 Grassed waterways	$100,000		
10 WASCOBs	$ 20,000		
Field Practices		9,000	15
Conservation tillage - 1000 acres	$100,000		
Nutrient management - 1000 acres	$ 50,000		
Streambank stabilization bioengineering (1200 feet)	$ 60,000	150	1
Streambank vegetation (1000 feet)	$ 10,000		
Wetland Restorations (5 sites)	$ 10,000	1,000	5
Livestock Exclusion (3 sites)	$ 10,000	150	10
Covered manure facility (3 sites)	$ 30,000		10
TOTAL	$400,000	16,300	56

VII. PROJECT CONSTRAINTS AND REMEDIES

As with most environmental restoration projects on public and private land, there are constraints which could keep the plan from being implemented. Some of the major potential constraints are listed in Table 9.

Table 10. Potential Project Constraints and Remedies

Proposed Action	Potential Constraints	Potential Remedies
Land Treatments	Treatment costs	Cost-share / Grants
Livestock Fencing	Fencing costs	Cost-share / Grants
Constructed Wetlands	Construction costs Loss of tillable land	Cost-share / Grants
Wetland Restorations	Loss of tillable land	Tax reduction / Grants

Aquatic Habitat Improvement	Extra drainage costs	None presently available
Manure Management	Costs to landowners	Cost-share / Grants

Because so many remedies rely on cost sharing and grants to defray the costs to local landowners, some of the potential grants available to fund implementation of this project are shown below:

IDNR LARE Program Indianapolis, IN	Nonpoint source planning, implementation (Ag BMPs)
IDEM 319 Program Indianapolis, IN	Nonpoint source planning, implementation (Ag BMPs)
IDEM Office of Land Quality Attn: Dennis Lasiter P.O. Box 6015 Indianapolis IN	Water quality improvement grant Manure handling.
Ducks Unlimited 331 Metty Dr., Ste. 4 Ann Arbor, MI 48103	Wetland restoration and construction
River Network P.O. Box 8787 Portland OR 97207	Watershed assistance grants
Cinergy Foundation 139 E. Fourth Street Cincinnati OH 45202	Environmental restoration grants
Pioneer Hi-bred Intl. 400 Locust Street Des Moines IA 50309	Agricultural environmental grants
U.S. Fish & Wildlife 4401 N. Fairfax Dr., Room 110 Arlington VA 22203	North American Wetlands Conservation Grants

Philip Morris Environment Program Manager 120 Park Ave.,17th Floor New York NY 10017	Environmental grant program Water quality enhancement
National Fish & Wildlife Foundation 1120 Connecticut Ave. NW Suite 900 Washington, D.C.	“Bring back the natives” watershed restoration grant Five Star Restoration Program
NRCS County SWCD Offices	Wildlife Habitat Incentives Program

There are institutions already in place to help carry out the plan. Names, phone numbers, and affiliations are shown below:

Name	***Phone***	***Affiliation***	***Assistance***
	765-747-5531	NRCS (Delaware Co.)	BMPs
Scott Mynberger	260-726-4373	NRCS (Jay Co.)	
Randolph Maggart	765-584-4505	NRCS (Randolph Co.)	
Jim Norris	765-747-5531	IDNR - Delaware/Randolph	Cost-share
Dennis Chenoweth	260-726-4373	IDNR - Jay Co.	
Rachael Wilson	765-584-4505 Ext. 3	Randolph Co.	
Jeff Kiefer	812-334-4261	U.S. Fish & Wildlife Service	wetland restoration
Jacqui Bauer	317-638-9302	Rural Community Assistance	construction & planning grants

VIII. PUBLIC PARTICIPATION

A public meeting was held November 20, 2003 at Delta Middle School near Albany. Twenty-eight people attended (see participant list in the Appendix). A flier explaining the purpose of the project and its results was prepared and passed out to each person attending the opening meeting (a copy is included in the Appendix). There was a question and answer period. Students from Taylor University were present to observe the process. Several people wanted to know whether funding was available to fix the problems identified by the study. Others asked about the danger of E.coli in the water. One person identified a site in the watershed where chicken manure was being land-applied and asked whether a permit had been issued for this.

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Habitat Evaluation Results

Habitat (QHEI) Scoring Results by Individual Metrics

	Site Number												
	1	2	3	4	5	6	7	8	9	10	11	12	Ref
SUBSTRATE	10	10	10	10	8	6	8	11	10	10	10	4	10
COVER	6	10	9	6	6	4	6	8	8	6	8	3	10
CHANNEL	8	14	11	12	7	6	7	13	8	11	8	4	12
RIPARIAN	9	11	11	6	6	5	3	13	10	6	7	5	12
POOL/RIFFLE	10	7	13	7	7	4	4	9	8	7	7	6	14
GRADIENT	6	6	6	10	8	6	8	8	4	8	4	4	10
DRAINAGE AREA	12	13	13	6	8	6	7	7	7	8	7	9	9
TOTAL	61	71	73	57	50	37	43	69	55	56	51	35	77

Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

Ohio EPA Site Description Sheet - Fish

Stream Stoney Creek RM ___ Date 05/02/01 River Code Site #1
Location Tay County USGS Quad ___
Township ___ Section ___ Lat/Long ___ / ___
Crew: Reference Site County ___

77 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES); % POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
				Check ALL That Apply:
□□-BOULDER [7]	___	☑☑-GRAVEL [5]	___ ___	□-SILT COVERED [-1]
□□-COBBLE [6]	___	☑□-SAND [4]	___ ___	☑-SILT FREE [1]
□□-HARDPAN [3]	___	□□-BEDROCK[3]	___ ___	□-BOULDERS AS SLABS [1]
□□-SILT [3]	___	□□-DETRITUS[2]	___ ___	□-EMBEDDED [-2]
□□-MUCK [2]	___	□□-SLUDGE[1]	___ ___	

COMMENTS ___

10 SUBSTRATE

2] INSTREAM COVER

TYPE (Check ALL That Apply)		AMOUNT(Check ONLY One)
☑- UNDERCUT BANKS [1]	☑- DEEP POOLS [1]	□- EXTENSIVE [7]
☑- OVERHANGING VEGETATION [1]	□- OXBOWS [1]	☑- MODERATE [5]
☑- SHALLOWS (IN SLOW WATER) [1]	□- BOULDERS [1]	□- SPARSE [3]
☑- LOGS OR WOODY DEBRIS [1]	□- AQUATIC MACROPHYTES [1]	□- NEARLY ABSENT [1]

COMMENTS: ___

10 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
□- HIGH [4]	□- EXCELLENT [4]	□- NONE [4]	☑- HIGH [3]	□- IMPOUND.
☑- MODERATE [3]	☑- GOOD [3]	☑- RECOVERED [3]	□- MODERATE [2]	☑- ISLANDS
□- LOW [2]	□- FAIR [2]	□- RECOVERING [2]	□- LOW [1]	□- LEVEED
□- NONE [1]	□- POOR [1]	□- RECENT OR NO RECOVERY [1]		

COMMENTS: ___

12 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH	FLOOD PLAIN QUALITY		BANK EROSION
L R (Per Bank)	(Check 2 Most Predominant)		L R (Per Bank)
□ □-EXTENSIVE >100m [5]	☑□-FOREST, SWAMP [3]	□□-URBAN [1]	□□-NONE [3]
□ □-WIDE 50-100m [4]	□□-OPEN PASTURE [0]	□□-ROWCROP [1]	☑☑-LITTLE [4]
□ ☑-MODERATE 10-50m [3]	☑☑-OLD FIELD [2]	□□-SHRUB [4]	□□-MODER.[3]
☑ ☑-NARROW 5-10m [2]	□□-RESIDENTIAL,PARK [2]		□□-HEAVY [2]
□ □-VERY NARROW 1-5m [1]	☑☑-CONSERV. TILLAGE [2]		□□-SEVERE [1]
□ □-NONE [0]	□□-FENCED PASTURE [2]		

COMMENTS: ___

12 RIPARIAN

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)	POOL COVER (Check 1)	OVERALL CURRENT VELOCITY (Check ALL That Apply)		MORPHOLOGY (Check 1)
☑- >1m [6]	□-EXTENSIVE [3]	□-TORRENTIAL[-1]	□-EDDIES[1]	☑-POOL WIDTH > RIFFLE WIDTH [2]
□- 0.7-1m [2]	☑-MODERATE [2]	☑-FAST[1]	□-INTERSTITIAL[-1]	□-POOL WIDTH = RIFFLE WIDTH [1]
□- 0.4-0.7m [1]	□-SPARSE [1]	☑-MODERATE [1]		□-POOL WIDTH < RIFFLE W. [0]
□- <0.4m [0]	□-NEARLY ABSENT [0]	☑-SLOW [1]		
		□-INTERMITTENT[-2]		

□-NO POOL[0] COMMENTS: ___

RIFFLE/RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN SUBSTRATE QUALITY
□- GENERALLY <10 cm [1]	☑- STABLE (Cobble, Boulder) [1]	□- EMBEDDED [0]
☑- GENERALLY >10 cm,MAX<50 [2]	□- UNSTABLE (Gravel, Sand) [0]	☑- NOT EMBED. [1]
□- GENERALLY >10 cm,MAX>50 [3]		6] Gradient (ft/mi): ___
□- NO RIFFLE[0]		7] Drainage area (sq.mi.): ___

14 POOL/RIFFLE

10 GRADIENT

9 DRAINAGE AREA

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Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

Ohio EPA Site Description Sheet – Fish 5/29/03

Stream Half Way Creek RM ____ Date ____ River Code ____
Location ____ USGS Quad ____
Township ____ Section ____ Latt./Longit ____ / ____
Crew: ____ County ____

35 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES); % POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
				Check ALL That Apply:
☐☐-BOULDER [7]	____ ____	☐☐-GRAVEL [5]	____ ____	X-SILT COVERED [-1]
☐☐-COBBLE [6]	____ ____	☐☐-SAND [4]	____ ____	☐-SILT FREE [1]
☐☐-HARDPAN [3]	____ ____	☐☐-BEDROCK [3]	____ ____	☐-BOULDERS AS SLABS [1]
☐X-SILT [2]	____ ____	☐☐-DETRITUS [2]	____ ____	☐-EMBEDDED [-2]
☐X-MUCK [2]	____ ____	☐☐-SLUDGE [1]	____ ____	

COMMENTS ____

4 SUBSTRATE

2] INSTREAM COVER

TYPE (Check ALL That Apply)		AMOUNT (Check ONLY One)
X- UNDERCUT BANKS [1]	☐- DEEP POOLS [1]	☐- EXTENSIVE [7]
X- OVERHANGING VEGETATION [1]	☐- OXBOWS [1]	☐- MODERATE [5]
☐- SHALLOWS (IN SLOW WATER) [1]	☐- BOULDERS [1]	☐- SPARSE [3]
☐- LOGS OR WOODY DEBRIS [1]	☐- AQUATIC MACROPHYTES [1]	X- NEARLY ABSENT [1]

COMMENTS: ____

3 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
☐- HIGH [4]	☐- EXCELLENT [4]	☐- NONE [4]	☐- HIGH [3]	☐- IMPOUND.
☐- MODERATE [3]	☐- GOOD [3]	☐- RECOVERED [3]	☐- MODERATE [2]	☐- ISLANDS
☐- LOW [2]	☐- FAIR [2]	☐- RECOVERING [2]	X- LOW [1]	☐- LEVEED
X- NONE [1]	X- POOR [1]	X- RECENT OR NO RECOVERY [1]		

COMMENTS: ____

4 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH	FLOOD PLAIN QUALITY		BANK EROSION
L R (Per Bank)	(Check 2 Most Predominant)		L R (Per Bank)
☐ ☐-EXTENSIVE >100m [5]	☐☐-FOREST, SWAMP [3]	☐☐-URBAN [1]	☐☐-NONE [5]
☐ ☐-WIDE 50-100m [4]	☐☐-OPEN PASTURE [3]	☐☐-ROWCROP [1]	☐☐-LITTLE [4]
☐ ☐-MODERATE 10-50m [3]	☐☐-OLD FIELD [3]	☐☐-SHRUB [4]	☐☐-MODER. [3]
☐ ☐-NARROW 5-10m [2]	☐X-RESIDENTIAL, PARK [2]		XX-HEAVY [2]
☐ X-VERY NARROW 1-5m [1]	☐X-CONSERV. TILLAGE [2]		☐☐-SEVERE [1]
☐ X-NONE [0]	☐☐-FENCED PASTURE [2]		

COMMENTS: ____

5 RIPARIAN

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)	POOL COVER (Check 1)	OVERALL CURRENT VELOCITY (Check ALL That Apply)		MORPHOLOGY (Check 1)
☐- >1m [3]	☐-EXTENSIVE [3]	☐-TORRENTIAL [-1]	☐-EDDIES [1]	X-POOL WIDTH > RIFFLE WIDTH [2]
☐- 0.7-1m [2]	☐-MODERATE [2]	☐-FAST [1]	☐-INTERSTITIAL [-1]	☐-POOL WIDTH = RIFFLE WIDTH [1]
X- 0.4-0.7m [1]	☐-SPARSE [1]	☐-MODERATE [1]		☐-POOL WIDTH < RIFFLE W. [0]
☐- <0.4m [0]	X-NEARLY ABSENT [0]	X-SLOW [1]		
		☐-INTERMITTENT [-2]		

☐-NO POOL [0] COMMENTS: ____

6 POOL/RIFFLE

RIFFLE/RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN SUBSTRATE QUALITY
X- GENERALLY <10 cm [1]	☐- STABLE (Cobble, Boulder) [1]	☐- EMBEDDED [0]
☐- GENERALLY >10 cm, MAX<50 [2]	X- UNSTABLE (Gravel, Sand) [0]	X- NOT EMBED. [1]
☐- GENERALLY >10 cm, MAX>50 [3]		
☐- NO RIFFLE [0]		

6] Gradient (ft/mi): ____ 3'/mi.
7] Drainage area (sq.mi.): ____

4 GRADIENT 9 DRAINAGE

Fresh dead

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Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

11

Ohio EPA Site Description Sheet - Fish 5/29/03

Stream Platt N. Drainage RM Date River Code

Location 3R28 USGS Quad

Township Section Latit./Longit. /

Crew: County

51 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES);% POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
				Check ALL That Apply:
☐☐-BOULDER [7]		☐☒-GRAVEL [3]		☐-SILT COVERED [-1]
☐☐-COBBLE [6]		☐☒-SAND [4]		☒-SILT FREE [1]
☐☐-HARDPAN [3]		☐☐-BEDROCK[5]		☐-BOULDERS AS SLABS [1]
☐☐-SILT [3]		☐☐-DETRITUS[2]		☐-EMBEDDED [-2]
☐☐-MUCK [2]		☐☐-SLUDGE[1]		

COMMENTS

10 SUBSTRATE

2] INSTREAM COVER

TYPE (Check ALL That Apply)		AMOUNT(Check ONLY One)
☐- UNDERCUT BANKS [1]	☐- DEEP POOLS [1]	☐-EXTENSIVE [7]
☒- OVERHANGING VEGETATION [1]	☐- OXBOWS [1]	☒-MODERATE [3]
☐- SHALLOWS (IN SLOW WATER) [1]	☐- BOULDERS [1]	☐-SPARSE [3]
☒- LOGS OR WOODY DEBRIS [1]	☐- AQUATIC MACROPHYTES [1]	☐-NEARLY ABSENT [1]

COMMENTS:

8 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
☐-HIGH [4]	☐-EXCELLENT [4]	☐-NONE [4]	☐-HIGH [3]	☐-IMPOUND.
☐-MODERATE [3]	☐-GOOD [3]	☐-RECOVERED [3]	☒-MODERATE [2]	☐-ISLANDS
☒-LOW [2]	☒-FAIR [2]	☒-RECOVERING [2]	☐-LOW [1]	☐-LEVEED
☐-NONE [1]	☐-POOR [1]	☐-RECENT OR NO RECOVERY [1]		

COMMENTS:

8 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH	FLOOD PLAIN QUALITY		BANK EROSION
L R (Per Bank)	(Check 2 Most Predominant)		L R (Per Bank)
☐ ☐-EXTENSIVE >100m [5]	☐☐-FOREST, SWAMP [3]	☐☐-URBAN [1]	☐☐-NONE [3]
☐ ☐-WIDE 50-100m [4]	☐☐-OPEN PASTURE [3]	☒☐-ROWCROP[1]	☒☒-LITTLE [4]
☐ ☒-MODERATE 10-50m [3]	☐☐-OLD FIELD [2]	☐☐-SHRUB [4]	☐☐-MODER.[3]
☐ ☒-NARROW 5-10m [2]	☐☒-RESIDENTIAL, PARK [2]		☐☐-HEAVY [2]
☐ ☐-VERY NARROW 1-5m [1]	☐☐-CONSERV. TILLAGE [2]		☐☐-SEVERE [1]
☐ ☐-NONE [0]	☐☐-FENCED PASTURE [2]		

COMMENTS:

7 RIPARIAN

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)	POOL COVER (Check 1)	OVERALL CURRENT VELOCITY (Check ALL That Apply)		MORPHOLOGY (Check 1)
☐- >1m [3]	☐-EXTENSIVE [3]	☐-TORRENTIAL[-1]	☐-EDDIES[1]	☐-POOL WIDTH > RIFFLE WIDTH [2]
☐- 0.7-1m [2]	☒-MODERATE [2]	☐-FAST[1]	☐-INTERSTITIAL[-1]	
☐- 0.4-0.7m [1]	☐-SPARSE [1]	☒-MODERATE [1]		☒-POOL WIDTH = RIFFLE WIDTH [1]
☒- <0.4m [0]	☐-NEARLY ABSENT [0]	☐-SLOW [1]		
		☐-INTERMITTENT[-2]		☐-POOL WIDTH < RIFFLE W. [0]

☐-NO POOL[0] COMMENTS:

7 POOL/ RIFFLE

RIFFLE/RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN SUBSTRATE QUALITY
☒- GENERALLY <10 cm [1]	☒- STABLE (Cobble, Boulder) [1]	☐- EMBEDDED [0]
☐- GENERALLY >10 cm,MAX<50 [2]	☐- UNSTABLE (Gravel, Sand) [0]	☒- NOT EMBED. [1]
☐- GENERALLY >10 cm,MAX>50 [3]		6] Gradient (ft/mi):
☐- NO RIFFLE[0]		7] Drainage area (sq.mi.):

2'/mi

4 GRADIENT

7 DRAINAGE

(10)

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(10)

Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

Ohio EPA Site Description Sheet - Fish 5/29/13

Stream Days Creek RM Date River Code
Location USGS Quad
Township Section Latt./Longit. /
Crew: County

56 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES); POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
☐☐-BOULDER [7]		☒☒-GRAVEL [5]		Check ALL That Apply:
☐☐-COBBLE [6]		☒☒-SAND [4]		☐-SILT COVERED [-1]
☐☐-HARDPAN [3]		☐☐-BEDROCK[5]		☒-SILT FREE [1]
☐☐-SILT [3]		☐☐-DETRITUS[2]		☐-BOULDERS AS SLABS [1]
☐☐-MUCK [2]		☐☐-SLUDGE[1]		☐-EMBEDDED [-2]

COMMENTS

10 SUBSTRATE

2] INSTREAM COVER

TYPE (Check ALL That Apply)		AMOUNT(Check ONLY One)
☒- UNDERCUT BANKS [1]	☐- DEEP POOLS [1]	☐-EXTENSIVE [7]
☒- OVERHANGING VEGETATION [1]	☐- OXBOWS [1]	☐-MODERATE [5]
☒- SHALLOWS (IN SLOW WATER) [1]	☐- BOULDERS [1]	☒-SPARSE [3]
☒- LOGS OR WOODY DEBRIS [1]	☐- AQUATIC MACROPHYTES [1]	☐-NEARLY ABSENT [1]

COMMENTS:

6 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
☐-HIGH [4]	☐-EXCELLENT [4]	☒-NONE [4]	☐-HIGH [3]	☐-IMPOUND.
☒-MODERATE [3]	☐-GOOD [3]	☐-RECOVERED [3]	☒-MODERATE [2]	☐-ISLANDS
☐-LOW [2]	☒-FAIR [2]	☐-RECOVERING [2]	☐-LOW [1]	☐-LEVEED
☐-NONE [1]	☐-POOR [1]	☐-RECENT OR NO RECOVERY [1]		

COMMENTS:

11 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH L R (Per Bank)	FLOOD PLAIN QUALITY (Check 2 Most Predominant)		BANK EROSION L R (Per Bank)
☐ ☐-EXTENSIVE >100m [5]	☐☐-FOREST, SWAMP [3]	☐☐-URBAN [1]	☐☐-NONE [3]
☐ ☐-WIDE 50-100m [4]	☐☐-OPEN PASTURE [1]	☒☒-ROWCROP[1]	☐☐-LITTLE [4]
☐ ☐-MODERATE 10-50m [3]	☐☐-OLD FIELD [2]	☐☐-SHRUB [4]	☒☒-MODER.[3]
☒ ☒-NARROW 5-10m [2]	☐☐-RESIDENTIAL,PARK [2]		☐☐-HEAVY [2]
☐ ☐-VERY NARROW 1-5m [1]	☐☐-CONSERV. TILLAGE [2]		☐☐-SEVERE [1]
☐ ☐-NONE [0]	☐☐-FENCED PASTURE [2]		

COMMENTS:

6 RIPARIAN

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)	POOL COVER (Check 1)	OVERALL CURRENT VELOCITY (Check ALL That Apply)		MORPHOLOGY (Check 1)
☐- >1m [3]	☐-EXTENSIVE [3]	☐-TORRENTIAL[-1]	☐-EDDIES[1]	☒-POOL WIDTH > RIFFLE WIDTH [2]
☐-0.7-1m [2]	☐-MODERATE [2]	☐-FAST[1]	☐-INTERSTITIAL[-1]	☐-POOL WIDTH = RIFFLE WIDTH [1]
☒-0.4-0.7m [1]	☒-SPARSE [1]	☒-MODERATE [1]		☐-POOL WIDTH < RIFFLE W. [0]
☐- <0.4m [0]	☐-NEARLY ABSENT [0]	☐-SLOW [1]		
		☐-INTERMITTENT[-2]		

☐-NO POOL[0] COMMENTS:

7 POOL/RIFFLE

RIFFLE/RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN SUBSTRATE QUALITY
☒- GENERALLY <10 cm [1]	☐- STABLE (Cobble, Boulder) [1]	☐-EMBEDDED [0]
☐- GENERALLY >10 cm,MAX<50 [2]	☒- UNSTABLE (Gravel, Sand) [0]	☒-NOT EMBED. [1]
☐- GENERALLY >10 cm,MAX>50 [3]		
☐- NO RIFFLE[0]		

6] Gradient (ft/mi): 8'/mi
7] Drainage area (sq.mi.):

8 GRADIENT

8 DRAINAGE

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9 9

Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

5/29/03

Ohio EPA Site Description Sheet - Fish

55 TOTAL QHEI

Stream Mud Cr RM Date River Code
Location 670 N (≈ 664 N) USGS Quad
Township Section Latit./Longit. /
Crew: County

1] SUBSTRATE (Check ONLY Two Substrate TYPES); % POOL/RIFFLE SUBSTRATES OPTIONAL

10 SUBSTRATE

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY Check ALL That Apply:
□□-BOULDER [7]		□□-GRAVEL [5]		□-SILT COVERED [-1]
□□-COBBLE [6]		□□-SAND [4]		□-SILT FREE [1]
□□-HARDPAN [3]		□□-BEDROCK[3]		□-BOULDERS AS SLABS [1]
□□-SILT [3]		□□-DETRITUS[2]		□-EMBEDDED [-2]
□□-MUCK [2]		□□-SLUDGE[1]		

COMMENTS

2] INSTREAM COVER

8 COVER

TYPE (Check ALL That Apply)		AMOUNT (Check ONLY One)
□- UNDERCUT BANKS [1]	□- DEEP POOLS [1]	□- EXTENSIVE [7]
□- OVERHANGING VEGETATION [1]	□- OXBOWS [1]	□- MODERATE [5]
□- SHALLOWS (IN SLOW WATER) [1]	□- BOULDERS [1]	□- SPARSE [3]
□- LOGS OR WOODY DEBRIS [1]	□- AQUATIC MACROPHYTES [1]	□- NEARLY ABSENT [1]

COMMENTS:

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

8 CHANNEL

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
□- HIGH [4]	□- EXCELLENT [4]	□- NONE [4]	□- HIGH [3]	□- IMPOUND.
□- MODERATE [3]	□- GOOD [3]	□- RECOVERED [3]	□- MODERATE [2]	□- ISLANDS
□- LOW [2]	□- FAIR [2]	□- RECOVERING [2]	□- LOW [1]	□- LEVEED
□- NONE [1]	□- POOR [1]	□- RECENT OR NO RECOVERY [1]		

COMMENTS:

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

10 RIPARIAN

RIPARIAN WIDTH L R (Per Bank)	FLOOD PLAIN QUALITY (Check 2 Most Predominant)		BANK EROSION L R (Per Bank)
□ □-EXTENSIVE >100m [5]	□□-FOREST, SWAMP [3]	□□-URBAN [1]	□□-NONE [5]
□ □-WIDE 50-100m [4]	□□-OPEN PASTURE [3]	□□-ROWCROP [1]	□□-LITTLE [4]
□ □-MODERATE 10-50m [3]	□□-OLD FIELD [3]	□□-SHRUB [4]	□□-MODER. [3]
□ □-NARROW 5-10m [2]	□□-RESIDENTIAL, PARK [2]		□□-HEAVY [2]
□ □-VERY NARROW 1-5m [1]	□□-CONSERV. TILLAGE [2]		□□-SEVERE [1]
□ □-NONE [0]	□□-FENCED PASTURE [2]		

COMMENTS:

[5] POOL/GLIDE AND RIFFLE/RUN QUALITY

8 POOL/ RIFFLE

MAX. DEPTH (Check 1)	POOL COVER (Check 1)	OVERALL CURRENT VELOCITY (Check ALL That Apply)		MORPHOLOGY (Check 1)
□- >1m [3]	□-EXTENSIVE [3]	□-TORRENTIAL[-1]	□-EDDIES[1]	□-POOL WIDTH > RIFFLE WIDTH [2]
□- 0.7-1m [2]	□-MODERATE [2]	□-FAST[1]	□-INTERSTITIAL[-1]	□-POOL WIDTH = RIFFLE WIDTH [1]
□- 0.4-0.7m [1]	□-SPARSE [1]	□-MODERATE [1]		□-POOL WIDTH < RIFFLE W. [0]
□- <0.4m [0]	□-NEARLY ABSENT [0]	□-SLOW [1]		
		□-INTERMITTENT[-2]		

□-NO POOL[0] COMMENTS:

RIFFLE/RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN SUBSTRATE QUALITY
□- GENERALLY <10 cm [1]	□- STABLE (Cobble, Boulder) [1]	□- EMBEDDED [0]
□- GENERALLY >10 cm, MAX<50 [2]	□- UNSTABLE (Gravel, Sand) [0]	□- NOT EMBED. [1]
□- GENERALLY >10 cm, MAX>50 [3]		
□- NO RIFFLE[0]		

6] Gradient (ft/mi): ______ 2'/mi 4 GRADIENT
7] Drainage area (sq.mi.): ______ 7 DRAINAGE

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(6)

Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

Ohio EPA Site Description Sheet – Fish 5/29/95

Stream Elkhorn RM Date River Code
Location 600 N USGS Quad
Township Section Latit./Longit. /
Crew: County

69 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES); % POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
				Check ALL That Apply:
☐☐-BOULDER [7]		☐☐-GRAVEL [5]		☐-SILT COVERED [-1]
☐☒COBBLE [6]		☐☒-SAND [4]		☒-SILT FREE [1]
☐☐-HARDPAN [3]		☐☐-BEDROCK[5]		☐-BOULDERS AS SLABS [1]
☐☐-SILT [2]		☐☐-DETRITUS[2]		☐-EMBEDDED [-2]
☐☐-MUCK [2]		☐☐-SLUDGE[1]		

COMMENTS

11 SUBSTRATE

2] INSTREAM COVER

TYPE (Check ALL That Apply)		AMOUNT (Check ONLY One)
☒- UNDERCUT BANKS [1]	☐- DEEP POOLS [1]	☐- EXTENSIVE [7]
☒- OVERHANGING VEGETATION [1]	☐- OXBOWS [1]	☒-MODERATE [5]
☐- SHALLOWS (IN SLOW WATER) [1]	☐- BOULDERS [1]	☐-SPARSE [3]
☒- LOGS OR WOODY DEBRIS [1]	☐- AQUATIC MACROPHYTES [1]	☐-NEARLY ABSENT [1]

COMMENTS:

8 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
☐- HIGH [4]	☐- EXCELLENT [4]	☒- NONE [4]	☒- HIGH [3]	☐- IMPOUND.
☒- MODERATE [3]	☒- GOOD [3]	☐- RECOVERED [3]	☐- MODERATE [2]	☐- ISLANDS
☐- LOW [2]	☐- FAIR [2]	☐- RECOVERING [2]	☐- LOW [1]	☐- LEVEED
☐- NONE [1]	☐- POOR [1]	☐- RECENT OR NO RECOVERY [1]		

COMMENTS:

13 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH	FLOOD PLAIN QUALITY		BANK EROSION
L R (Per Bank)	(Check 2 Most Predominant)		L R (Per Bank)
☒☒-EXTENSIVE >100m [3]	☒☐-FOREST, SWAMP [3]	☐☐-URBAN [1]	☐☐-NONE [3]
☐ ☐-WIDE 50-100m [4]	☐☐-OPEN PASTURE [1]	☐☐-ROWCROP [1]	☒☒-LITTLE [4]
☐ ☐-MODERATE 10-50m [3]	☐☐-OLD FIELD [3]	☐☐-SHRUB [4]	☐☐-MODER.[3]
☐ ☐-NARROW 5-10m [2]	☐☐-RESIDENTIAL,PARK [2]		☐☐-HEAVY [2]
☐ ☐-VERY NARROW 1-5m [1]	☐☒-CONSERV. TILLAGE [2]		☐☐-SEVERE [1]
☐ ☐-NONE [0]	☐☐-FENCED PASTURE [2]		

COMMENTS:

13 RIPARIAN

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)	POOL COVER (Check 1)	OVERALL CURRENT VELOCITY (Check ALL That Apply)		MORPHOLOGY (Check 1)
☐- >1m [5]	☒-EXTENSIVE [3]	☐-TORRENTIAL[-1]	☐-EDDIES[1]	☒-POOL WIDTH > RIFFLE WIDTH [2]
☐-0.7-1m [2]	☐-MODERATE [2]	☐-FAST[1]	☐-INTERSTITIAL[-1]	
☐-0.4-0.7m [1]	☐-SPARSE [1]	☒-MODERATE [1]		☐-POOL WIDTH = RIFFLE WIDTH [1]
☒- <0.4m [0]	☐-NEARLY ABSENT [0]	☐-SLOW [1]		
		☐-INTERMITTENT[-2]		☐-POOL WIDTH < RIFFLE W. [0]

☐-NO POOL[0] COMMENTS:

9 POOL/RIFFLE

RIFFLE/RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN SUBSTRATE QUALITY
☒- GENERALLY <10 cm [1]	☒- STABLE (Cobble, Boulder) [1]	☐- EMBEDDED [0]
☐- GENERALLY >10 cm,MAX<50 [2]		☒- NOT EMBED. [1]
☐- GENERALLY >10 cm,MAX>50 [3]	☐- UNSTABLE (Gravel, Sand) [0]	
☐- NO RIFFLE[0]		

6] Gradient (ft/mi): ______ 19'/mi
7] Drainage area (sq.mi.): ______

8 GRADIENT 7 DRAINAGE

(7)

Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

5/29/13

Ohio EPA Site Description Sheet – Fish

Stream Bush Cr. RM ____ Date ____ River Code ____
Location 600 N ____ USGS Quad ____
Township ____ Section ____ Latit./Longit. ____/____
Crew: ____ County ____

43 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES); % POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
☐☐-BOULDER [7]	____	☐☒-GRAVEL [5]	____ ____	Check All That Apply:
☐☐-COBBLE [6]	____	☐☒-SAND [4]	____ ____	☒-SILT COVERED [-1]
☐☐-HARDPAN [3]	____	☐☐-BEDROCK [5]	____ ____	☐-SILT FREE [1]
☐☐-SILT [3]	____	☐☐-DETRITUS [2]	____ ____	☐-BOULDERS AS SLABS [1]
☐☐-MUCK [2]	____	☐☐-SLUDGE [1]	____ ____	☐-EMBEDDED [-2]

COMMENTS ____

8 SUBSTRATE

2] INSTREAM COVER

TYPE (Check All That Apply)		AMOUNT (Check ONLY One)
☒- UNDERCUT BANKS [1]	☐- DEEP POOLS [1]	☐- EXTENSIVE [7]
☒- OVERHANGING VEGETATION [1]	☐- OXBOWS [1]	☒- MODERATE [5]
☒- SHALLOWS (IN SLOW WATER) [1]	☐- BOULDERS [1]	☒- SPARSE [3]
☐- LOGS OR WOODY DEBRIS [1]	☐- AQUATIC MACROPHYTES [1]	☐- NEARLY ABSENT [1]

COMMENTS: ____

6 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
☐- HIGH [4]	☐- EXCELLENT [4]	☐- NONE [4]	☐- HIGH [3]	☐- IMPOUND.
☐- MODERATE [3]	☐- GOOD [3]	☐- RECOVERED [3]	☐- MODERATE [2]	☐- ISLANDS
☒- LOW [2]	☒- FAIR [2]	☒- RECOVERING [2]	☒- LOW [1]	☐- LEVEED
☐- NONE [1]	☐- POOR [1]	☐- RECENT OR NO RECOVERY [1]		

COMMENTS: ____

7 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH L R (Per Bank)	FLOOD PLAIN QUALITY (Check 2 Most Predominant)		BANK EROSION L R (Per Bank)
☐ ☐-EXTENSIVE >100m [5]	☐☐-FOREST, SWAMP [5]	☐☐-URBAN [1]	☐☐-NONE [5]
☐ ☐-WIDE 50-100m [4]	☐☒-OPEN PASTURE [3]	☐☐-ROWCROP [1]	☐☐-LITTLE [4]
☐ ☐-MODERATE 10-50m [3]	☐☐-OLD FIELD [3]	☐☐-SHRUB [4]	☐☐-MODER. [3]
☐ ☐-NARROW 5-10m [2]	☐☐-RESIDENTIAL, PARK [2]		☐☐-HEAVY [2]
☐ ☒-VERY NARROW 1-5m [1]	☐☐-CONSERV. TILLAGE [2]		☒☒-SEVERE [1]
☐ ☐-NONE [0]	☐☐-FENCED PASTURE [2]		

COMMENTS: ____

3 RIPARIAN

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)	POOL COVER (Check 1)	OVERALL CURRENT VELOCITY (Check All That Apply)		MORPHOLOGY (Check 1)
☐- >1m [3]	☐-EXTENSIVE [3]	☐-TORRENTIAL [-1]	☐-EDDIES [1]	☐-POOL WIDTH > RIFFLE WIDTH [2]
☐- 0.7-1m [2]	☐-MODERATE [2]	☐-FAST [1]	☐-INTERSTITIAL [-1]	☒-POOL WIDTH = RIFFLE WIDTH [1]
☐- 0.4-0.7m [1]	☐-SPARSE [1]	☒-MODERATE [1]		☐-POOL WIDTH < RIFFLE W. [0]
☒- <0.4m [0]	☒-NEARLY ABSENT [0]	☐-SLOW [1]		
		☐-INTERMITTENT [-2]		

☐-NO POOL [0] COMMENTS: ____

4 POOL/RIFFLE

RIFFLE/RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN SUBSTRATE QUALITY
☒- GENERALLY <10 cm [1]	☐- STABLE (Cobble, Boulder) [1]	☐- EMBEDDED [0]
☐- GENERALLY >10 cm, MAX<50 [2]	☒- UNSTABLE (Gravel, Sand) [0]	☒- NOT EMBED. [1]
☐- GENERALLY >10 cm, MAX>50 [3]		6] Gradient (ft./mi.): ____
☐- NO RIFFLE [0]		7] Drainage area (sq.mi.): ____

22'/mi

8 GRADIENT 7 DRAINAGE

6

Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

5/29/03

Ohio EPA Site Description Sheet - Fish

37 TOTAL QHEI

Stream Hess Ditch RM Date River Code
Location USGS Quad
Township Section Latit./Longit. /
Crew: County

1] SUBSTRATE (Check ONLY Two Substrate TYPES);% POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
				Check All That Apply:
☐☐-BOULDER [7]		☐☐-GRAVEL [5]		☐-SILT COVERED [-1]
☐☐-COBBLE [6]		☐☐-SAND [4]		☐-SILT FREE [1]
☐☐-HARDPAN [3]		☐☐-BEDROCK[5]		☐-BOULDERS AS SLABS [1]
☐☐-SILT [3]		☐☐-DETRITUS[2]		☐-EMBEDDED [-2]
☐☐-MUCK [2]		☐☐-SLUDGE[1]		

COMMENTS

6 SUBSTRATE

2] INSTREAM COVER

TYPE (Check All That Apply)
☐- UNDERCUT BANKS [1]
☐- OVERHANGING VEGETATION [1]
☐- SHALLOWS (IN SLOW WATER) [1]
☐- LOGS OR WOODY DEBRIS [1]
☐- DEEP POOLS [1]
☐- OXBOWS [1]
☐- BOULDERS [1]
☐- AQUATIC MACROPHYTES [1]

AMOUNT(Check ONLY One)
☐-EXTENSIVE [7]
☐-MODERATE [5]
☐-SPARSE [3]
☐-NEARLY ABSENT [1]

COMMENTS:

4 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
☐-HIGH [4]	☐-EXCELLENT [4]	☐-NONE [4]	☐-HIGH [3]	☐-IMPOUND.
☐-MODERATE [3]	☐-GOOD [3]	☐-RECOVERED [3]	☐-MODERATE [2]	☐-ISLANDS
☐-LOW [2]	☐-FAIR [2]	☐-RECOVERING [2]	☐-LOW [1]	☐-LEVEED
☐-NONE [1]	☐-POOR [1]	☐-RECENT OR NO RECOVERY [1]		

COMMENTS:

6 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH
L R (Per Bank)
☐ ☐-EXTENSIVE >100m [5]
☐ ☐-WIDE 50-100m [4]
☐ ☐-MODERATE 10-50m [3]
☐ ☐-NARROW 5-10m [2]
☐ ☐-VERY NARROW 1-5m [1]
☐ ☐-NONE [0]

FLOOD PLAIN QUALITY
(Check 2 Most Predominant)
☐☐-FOREST, SWAMP [3]
☐☐-OPEN PASTURE [3]
☐☐-OLD FIELD [2]
☐☐-RESIDENTIAL,PARK [2]
☐☐-CONSERV. TILLAGE [2]
☐☐-FENCED PASTURE [2]
☐☐-URBAN [1]
☐☐-ROWCROP[1]
☐☐-SHRUB [4]

BANK EROSION
L R (Per Bank)
☐☐-NONE [5]
☐☐-LITTLE [4]
☐☐-MODER.[3]
☐☐-HEAVY [2]
☐☐-SEVERE [1]

COMMENTS:

5 RIPARIAN

[5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)
☐- >1m [3]
☐-0.7-1m [2]
☐-0.4-0.7m [1]
☐- <0.4m [0]

POOL COVER (Check 1)
☐-EXTENSIVE [3]
☐-MODERATE [2]
☐-SPARSE [1]
☐-NEARLY ABSENT [0]

OVERALL CURRENT VELOCITY (Check All That Apply)
☐-TORRENTIAL[-1]
☐-EDDIES[1]
☐-FAST[1]
☐-INTERSTITIAL[-1]
☐-MODERATE [1]
☐-SLOW [1]
☐-INTERMITTENT[-2]

MORPHOLOGY (Check 1)
☐-POOL WIDTH > RIFFLE WIDTH [2]
☐-POOL WIDTH = RIFFLE WIDTH [1]
☐-POOL WIDTH < RIFFLE W. [0]

☐-NO POOL[0] COMMENTS:

4 POOL/RIFFLE

RIFFLE/RUN DEPTH
☐- GENERALLY <10 cm [1]
☐- GENERALLY >10 cm,MAX<50 [2]
☐- GENERALLY >10 cm,MAX>50 [3]
☐- NO RIFFLE[0]

RIFFLE/RUN SUBSTRATE
☐- STABLE (Cobble, Boulder) [1]
☐- UNSTABLE (Gravel, Sand) [0]

RIFFLE/RUN SUBSTRATE QUALITY
☐- EMBEDDED [0]
☐- NOT EMBED. [1]

6] Gradient (ft/mi): 6'/mi
7] Drainage area (sq.mi.):

6 GRADIENT

6 DRAINAGE

5

Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

Ohio EPA Site Description Sheet - Fish 5/29/03

Stream Bear Cr. RM Date River Code

Location USGS Quad

Township Section Latit./Longit. /

Crew: County

50 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES); % POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
				Check All That Apply:
□□-BOULDER [7]	___	□☒-GRAVEL [5]	___ ___	□-SILT COVERED [-1]
□□-COBBLE [6]	___	□□-SAND [4]	___ ___	☒-SILT FREE [1]
□□-HARDPAN [3]	___	□□-BEDROCK[5]	___ ___	□-BOULDERS AS SLABS [1]
□□-SILT [3]	___	□□-DETRITUS[2]	___ ___	□-EMBEDDED [-2]
□☒-MUCK [2]	___	□□-SLUDGE[1]	___ ___	

COMMENTS

8 SUBSTRATE

2] INSTREAM COVER

TYPE (Check All That Apply)		AMOUNT (Check ONLY One)
□- UNDERCUT BANKS [1]	□- DEEP POOLS [1]	□-EXTENSIVE [7]
☒- OVERHANGING VEGETATION [1]	□- OXBOWS [1]	☒-MODERATE [5]
□- SHALLOWS (IN SLOW WATER) [1]	□- BOULDERS [1]	□-SPARSE [3]
□- LOGS OR WOODY DEBRIS [1]	□- AQUATIC MACROPHYTES [1]	□-NEARLY ABSENT [1]

COMMENTS:

6 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
□-HIGH [4]	□-EXCELLENT [4]	□-NONE [4]	□-HIGH [3]	□-IMPOUND.
□-MODERATE [3]	□-GOOD [3]	□-RECOVERED [3]	□-MODERATE [2]	□-ISLANDS
☒-LOW [2]	☒-FAIR [2]	☒-RECOVERING [2]	☒-LOW [1]	□-LEVEED
□-NONE [1]	□-POOR [1]	□-RECENT OR NO RECOVERY [1]		

COMMENTS:

7 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH L R (Per Bank)	FLOOD PLAIN QUALITY (Check 2 Most Predominant)		BANK EROSION L R (Per Bank)
□ □-EXTENSIVE >100m [5]	□□-FOREST, SWAMP [5]	□□-URBAN [1]	□□-NONE [5]
□ □-WIDE 50-100m [4]	□□-OPEN PASTURE [1]	☒☒-ROWCROP [1]	☒☒-LITTLE [4]
□ □-MODERATE 10-50m [3]	□□-OLD FIELD [3]	□□-SHRUB [4]	□□-MODER.[3]
□ □-NARROW 5-10m [2]	□□-RESIDENTIAL, PARK [2]		□□-HEAVY [2]
☒ □-VERY NARROW 1-5m [1]	□□-CONSERV. TILLAGE [2]		□□-SEVERE [1]
□ □-NONE [0]	□□-FENCED PASTURE [2]		

COMMENTS:

6 RIPARIAN

[5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)	POOL COVER (Check 1)	OVERALL CURRENT VELOCITY (Check All That Apply)		MORPHOLOGY (Check 1)
□- >1m [3]	□-EXTENSIVE [3]	□-TORRENTIAL[-1]	□-EDDIES[1]	□-POOL WIDTH > RIFFLE WIDTH [2]
□- 0.7-1m [2]	□-MODERATE [2]	□-FAST[1]	□-INTERSTITIAL[-1]	☒-POOL WIDTH = RIFFLE WIDTH [1]
☒- 0.4-0.7m [1]	☒-SPARSE [1]	☒-MODERATE [1]		□-POOL WIDTH < RIFFLE W. [0]
□- <0.4m [0]	□-NEARLY ABSENT [0]	□-SLOW [1]		
		□-INTERMITTENT[-2]		

□-NO POOL[0] COMMENTS:

7 POOL/RIFFLE

RIFFLE/RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN SUBSTRATE QUALITY
☒- GENERALLY <10 cm [1]	☒-STABLE (Cobble, Boulder) [1]	□-EMBEDDED [0]
□- GENERALLY >10 cm, MAX<50 [2]	□-UNSTABLE (Gravel, Sand) [0]	☒-NOT EMBED. [1]
□- GENERALLY >10 cm, MAX>50 [3]		
□-NO RIFFLE[0]		

6] Gradient (ft/mi): ______ 8'/mi

7] Drainage area (sq.mi.): ______

8 GRADIENT 8 DRAINAGE

outer bank stabilized w/ rip-rap

4

Procedure No. WQMA-SWS-3 Date Issued 10/1/87
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Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

5/29/83

Ohio EPA Site Description Sheet - Fish

Stream: Feeder Creek RM Date River Code
Location USGS Quad
Township Section Latt./Longit. /
Crew: County

57 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES); % POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL	RIFFLE		POOL	RIFFLE	QUALITY
						Check All That Apply:
□□-BOULDER [7]			☒□-GRAVEL [5]			□-SILT COVERED [-1]
□□-COBBLE [6]			☒☒-SAND [4]			☒-SILT FREE [1]
□□-HARDPAN [3]			□□-BEDROCK [3]			□-BOULDERS AS SLABS [1]
□□-SILT [3]			□□-DETRITUS [2]			□-EMBEDDED [-2]
□□-MUCK [2]			□□-SLUDGE [1]			

COMMENTS:

10 SUBSTRATE

2] INSTREAM COVER

TYPE (Check All That Apply)
☒- UNDERCUT BANKS [1]
☒- OVERHANGING VEGETATION [1]
□- SHALLOWS (IN SLOW WATER) [1]
☒- LOGS OR WOODY DEBRIS [1]
□- DEEP POOLS [1]
□- OXBOWS [1]
□- BOULDERS [1]
□- AQUATIC MACROPHYTES [1]

AMOUNT (Check ONLY One)
□- EXTENSIVE [7]
☒- MODERATE [5]
☒- SPARSE [3]
□- NEARLY ABSENT [1]

COMMENTS:

6 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
□-HIGH [4]	□-EXCELLENT [4]	☒-NONE [4]	□-HIGH [3]	□-IMPOUND.
☒-MODERATE [3]	☒-GOOD [3]	□-RECOVERED [3]	☒-MODERATE [2]	□-ISLANDS
□-LOW [2]	□-FAIR [2]	□-RECOVERING [2]	□-LOW [1]	□-LEVEED
□-NONE [1]	□-POOR [1]	□-RECENT OR NO RECOVERY [1]		

COMMENTS:

12 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH
L R (Per Bank)
□ □-EXTENSIVE >100m [5]
□ □-WIDE 50-100m [4]
□ □-MODERATE 10-50m [3]
□ ☒-NARROW 5-10m [2]
□ □-VERY NARROW 1-5m [1]
□ □-NONE [0]

FLOOD PLAIN QUALITY
(Check 2 Most Predominant)
□□-FOREST, SWAMP [3] □□-URBAN [1]
□□-OPEN PASTURE [1] □☒-ROWCROP [1]
□□-OLD FIELD [3] □□-SHRUB [4]
☒□-RESIDENTIAL, PARK [2]
□□-CONSERV. TILLAGE [2]
□□-FENCED PASTURE [2]

BANK EROSION
L R (Per Bank)
□□-NONE [3]
□□-LITTLE [4]
☒☒-MODER. [3]
□□-HEAVY [2]
□□-SEVERE [1]

COMMENTS:

6 RIPARIAN

[5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)
□- >1m [3]
□- 0.7-1m [2]
☒- 0.4-0.7m [1]
□- <0.4m [0]

POOL COVER (Check 1)
□-EXTENSIVE [3]
☒-MODERATE [2]
□-SPARSE [1]
□-NEARLY ABSENT [0]

OVERALL CURRENT VELOCITY (Check All That Apply)
□-TORRENTIAL [-1] □-EDDIES [1]
□-FAST [1] □-INTERSTITIAL [-1]
☒-MODERATE [1]
□-SLOW [1]
□-INTERMITTENT [-2]

MORPHOLOGY (Check 1)
□-POOL WIDTH > RIFFLE WIDTH [2]
☒-POOL WIDTH = RIFFLE WIDTH [1]
□-POOL WIDTH < RIFFLE W. [0]

□-NO POOL [0] COMMENTS:

8 POOL/ RIFFLE

RIFFLE/RUN DEPTH
☒- GENERALLY <10 cm [1]
□- GENERALLY >10 cm, MAX<50 [2]
□- GENERALLY >10 cm, MAX>50 [3]
□- NO RIFFLE [0]

RIFFLE/RUN SUBSTRATE
☒- STABLE (Cobble, Boulder) [1]
☒- UNSTABLE (Gravel, Sand) [0]

RIFFLE/RUN SUBSTRATE QUALITY
□- EMBEDDED [0]
☒- NOT EMBED. [1]

6] Gradient (ft/mi):
7] Drainage area (sq.mi.):

12'/mi

10 GRADIENT

6 DRAINAGE

outer bank had been ... and concrete ... (handwritten, partly cut off)

(3)

Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

Ohio EPA Site Description Sheet – Fish 5/29/03

Stream Mississinewa R. RM ____ Date ____ River Code ____
Location Powder... ____ USGS Quad ____
Township ____ Section ____ Lat/Long ____ / ____
Crew: ____ County ____

73 / 65 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES); % POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY Check All That Apply:
□□-BOULDER [7]	____	☒☒-GRAVEL [5]	____ ____	☒-SILT COVERED [-1]
□□-COBBLE [6]	____	☒☒-SAND [4]	____ ____	☒-SILT FREE [1]
□□-HARDPAN [3]	____	□□-BEDROCK [5]	____ ____	□-EMBEDDED AS SLABS [1]
□□-SILT [2]	____	□□-DETRITUS [2]	____ ____	□-□-EMBEDDED [-2]
□□-MUCK [2]	____	□□-SLUDGE [1]	____ ____	

COMMENTS: ____

10 SUBSTRATE

2] INSTREAM COVER

TYPE (Check All That Apply)
□- UNDERCUT BANKS [1]
☒- OVERHANGING VEGETATION [1]
☒- SHALLOWS (IN SLOW WATER) [1]
☒- LOGS OR WOODY DEBRIS [1]
☒- DEEP POOLS [1]
□- OXBOWS [1]
□- BOULDERS [1]
□- AQUATIC MACROPHYTES [1]

AMOUNT (Check ONLY One)
□- EXTENSIVE [7]
☒- MODERATE [5]
□- SPARSE [3]
□- NEARLY ABSENT [1]

COMMENTS: ____

9 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
□-HIGH [4]	□-EXCELLENT [4]	☒-NONE [4]	□-HIGH [3]	□-IMPOUND.
☒-MODERATE [3]	□-GOOD [3]	□-RECOVERED [3]	☒-MODERATE [2]	□-ISLANDS
□-LOW [2]	☒-FAIR [2]	□-RECOVERING [2]	□-LOW [1]	□-LEVEED
□-NONE [1]	□-POOR [1]	□-RECENT OR NO RECOVERY [1]		

COMMENTS: ____

11 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH
L R (Per Bank)
□ ☒-EXTENSIVE >100m [5]
□ □-WIDE 50-100m [4]
□ ☒-MODERATE 10-50m [3]
□ □-NARROW 5-10m [2]
□ □-VERY NARROW 1-5m [1]
□ □-NONE [0]

FLOOD PLAIN QUALITY
(Check 2 Most Predominant)
□☒-FOREST, SWAMP [3] □□-URBAN [1]
□□-OPEN PASTURE [1] □□-ROWCROP [1]
□□-OLD FIELD [2] □□-SHRUB [4]
□☒-RESIDENTIAL, PARK [2]
□□-CONSERV. TILLAGE [2]
□□-FENCED PASTURE [2]

BANK EROSION
L R (Per Bank)
□□-NONE [3]
□□-LITTLE [4]
☒☒-MODERATE [3]
□□-HEAVY [2]
□□-SEVERE [1]

COMMENTS: ____

11 RIPARIAN

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)
☒->1m [6]
□-0.7-1m [4]
□-0.4-0.7m [1]
□-<0.4m [0]

POOL COVER (Check 1)
☒-EXTENSIVE [3]
☒-MODERATE [2]
□-SPARSE [1]
□-NEARLY ABSENT [0]

OVERALL CURRENT VELOCITY (Check All That Apply)
□-TORRENTIAL [-1] □-EDDIES [1]
☒-FAST [1] □-INTERSTITIAL [-1]
☒-MODERATE [1]
☒-SLOW [1]
□-INTERMITTENT [-2]

MORPHOLOGY (Check 1)
□-POOL WIDTH > RIFFLE WIDTH [2]
☒-POOL WIDTH = RIFFLE WIDTH [1]
□-POOL WIDTH < RIFFLE W. [0]

□-NO POOL [0] COMMENTS: ____

13 POOL/RIFFLE

RIFFLE/RUN DEPTH
☒-GENERALLY <10 cm [1]
□-GENERALLY >10 cm, MAX<50 [2]
□-GENERALLY >10 cm, MAX>50 [3]
☒-NO RIFFLE [0]

RIFFLE/RUN SUBSTRATE
☒-STABLE (Cobble, Boulder) [1]
□-UNSTABLE (Gravel, Sand) [0]

RIFFLE/RUN SUBSTRATE QUALITY
□-EMBEDDED [0]
☒-NOT EMBED. [1]

6] Gradient (ft/mi): ____ 5'/mi
7] Drainage area (sq.mi.): ____

6 GRADIENT

13 DRAINAGE AREA

Procedure No. WQMA-SWS-3 Date Issued 10/1/87
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Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

(2)

5/29/03

Ohio EPA Site Description Sheet - Fish

Stream Mississinewa RM ____ Date ____ River Code ____
Location middle - CR 850 N USGS Quad ____
Township ____ Section ____ Latit./Longit. ____ / ____
Crew: ____ County ____

71 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES); % POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
				Check ALL That Apply:
☐☐-BOULDER [7]	____	☐☐-GRAVEL [5]	____ ____	☐-SILT COVERED [-1]
☐☒-COBBLE [6]	____	☐☐-SAND [4]	____ ____	☒-SILT FREE [1]
☐☐-HARDPAN [3]	____	☒☒-BEDROCK[5]	____ ____	☐-BOULDERS AS SLABS [1]
☐☐-SILT [3]	____	☐☐-DETRITUS[2]	____ ____	☐-EMBEDDED [-2]
☐☐-MUCK [2]	____	☐☐-SLUDGE[1]	____ ____	

COMMENTS ____

10 SUBSTRATE

2] INSTREAM COVER

TYPE (Check ALL That Apply)
☐- UNDERCUT BANKS [1]
☒- OVERHANGING VEGETATION [1]
☒- SHALLOWS (IN SLOW WATER) [1]
☒- LOGS OR WOODY DEBRIS [1]
☐- DEEP POOLS [1]
☐- OXBOWS [1]
☒- BOULDERS [1]
☒- AQUATIC MACROPHYTES [1]

AMOUNT (Check ONLY One)
☐- EXTENSIVE [7]
☒- MODERATE [5]
☐- SPARSE [3]
☐- NEARLY ABSENT [1]

COMMENTS: ____

10 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
☒-HIGH [4]	☐-EXCELLENT [4]	☒-NONE [4]	☒-HIGH [3]	☐-IMPOUND.
☐-MODERATE [3]	☒-GOOD [3]	☐-RECOVERED [3]	☐-MODERATE [2]	☐-ISLANDS
☐-LOW [2]	☐-FAIR [2]	☐-RECOVERING [2]	☐-LOW [1]	☐-LEVEED
☐-NONE [1]	☐-POOR [1]	☐-RECENT OR NO RECOVERY [1]		

COMMENTS: ____

14 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH
L R (Per Bank)
☐ ☐-EXTENSIVE >100m [5]
☒ ☐-WIDE 50-100m [4]
☐ ☐-MODERATE 10-50m [3]
☐ ☐-NARROW 5-10m [2]
☐ ☐-VERY NARROW 1-5m [1]
☐ ☐-NONE [0]

FLOOD PLAIN QUALITY
(Check 2 Most Predominant)
☐☒-FOREST, SWAMP [3]
☐☐-OPEN PASTURE [1]
☐☐-OLD FIELD [2]
☒☒-RESIDENTIAL,PARK [2]
☐☐-CONSERV. TILLAGE [2]
☐☐-FENCED PASTURE [2]
☐☐-URBAN [1]
☐☐-ROWCROP [1]
☐☐-SHRUB [4]

BANK EROSION
L R (Per Bank)
☒☒-NONE [3]
☐☐-LITTLE [4]
☐☐-MODER.[3]
☐☐-HEAVY [2]
☐☐-SEVERE [1]

COMMENTS: ____

11 RIPARIAN

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)
☒->1m [3]
☐-0.7-1m [2]
☐-0.4-0.7m [1]
☐-<0.4m [0]

POOL COVER (Check 1)
☐-EXTENSIVE [3]
☒-MODERATE [2]
☐-SPARSE [1]
☐-NEARLY ABSENT [0]

OVERALL CURRENT VELOCITY (Check ALL That Apply)
☐-TORRENTIAL[-1]
☐-EDDIES[1]
☐-FAST[1]
☐-INTERSTITIAL[-1]
☒-MODERATE [1]
☐-SLOW [1]
☐-INTERMITTENT[-2]

MORPHOLOGY (Check 1)
☐-POOL WIDTH > RIFFLE WIDTH [2]
☒-POOL WIDTH = RIFFLE WIDTH [1]
☐-POOL WIDTH < RIFFLE W. [0]

☐-NO POOL[0] COMMENTS: ____

7 POOL/ RIFFLE

RIFFLE/RUN DEPTH
☐- GENERALLY <10 cm [1]
☐- GENERALLY >10 cm,MAX<50 [2]
☒- GENERALLY >10 cm,MAX>50 [3]
☐- NO RIFFLE[0]

RIFFLE/RUN SUBSTRATE
☒-STABLE (Cobble, Boulder) [1]
☐- UNSTABLE (Gravel, Sand) [0]

RIFFLE/RUN SUBSTRATE QUALITY
☐- EMBEDDED [0]
☐- NOT EMBED. [1]

6] Gradient (ft/mi): ____
7] Drainage area (sq.mi.): ____

5'/mi
6 GRADIENT
13 DRAINAGE

(1)

Figure V-4-1. Front side of the Ohio EPA Site Description Sheet for evaluating the geographical and physical characteristics of fish sampling locations. This is used to record information for the calculation of the Qualitative Habitat Evaluation Index (QHEI).

5/29/03

Ohio EPA Site Description Sheet - Fish

Stream Mississinewa RM____ Date____ River Code____
Location 100 W ____ USGS Quad____
Township____ Section____ Latit./Longit.____/____
Crew:____ County____

61 TOTAL QHEI

1] SUBSTRATE (Check ONLY Two Substrate TYPES);% POOL/RIFFLE SUBSTRATES OPTIONAL

TYPE	POOL RIFFLE		POOL RIFFLE	QUALITY
				Check All That Apply:
□□-BOULDER [7]	____	□☒-GRAVEL [5]	____ ____	□-SILT COVERED [-1]
□□-COBBLE [6]	____	□☒-SAND [4]	____ ____	☒-SILT FREE [1]
□□-HARDPAN [3]	____	□□-BEDROCK[3]	____ ____	□-BOULDERS AS SLABS [1]
□□-SILT [3]	____	□□-DETRITUS[2]	____ ____	□-EMBEDDED [-2]
□□-MUCK [2]	____	□□-SLUDGE[1]	____ ____	

COMMENTS____

10 SUBSTRATE

2] INSTREAM COVER

TYPE (Check All That Apply)		AMOUNT(Check ONLY One)
□- UNDERCUT BANKS [1]	□- DEEP POOLS [1]	□-EXTENSIVE [7]
☒- OVERHANGING VEGETATION [1]	□- OXBOWS [1]	□-MODERATE [5]
☒- SHALLOWS (IN SLOW WATER) [1]	□- BOULDERS [1]	☒-SPARSE [3]
☒- LOGS OR WOODY DEBRIS [1]	□- AQUATIC MACROPHYTES [1]	□-NEARLY ABSENT [1]

COMMENTS:____

6 COVER

3] CHANNEL MORPHOLOGY: (Check ONLY One Under Each Category)

SINUOSITY	DEVELOPMENT	CHANNELIZATION	STABILITY	OTHER
□-HIGH [4]	□-EXCELLENT [4]	□-NONE [4]	□-HIGH [3]	□-IMPOUND.
□-MODERATE [3]	□-GOOD [3]	☒-RECOVERED [3]	☒-MODERATE [2]	□-ISLANDS
☒-LOW [2]	☒-FAIR [2]	☒-RECOVERING [2]	□-LOW [1]	□-LEVEED
□-NONE [1]	□-POOR [1]	□-RECENT OR NO RECOVERY [1]		

COMMENTS:____

8 CHANNEL

4] RIPARIAN ZONE AND BANK EROSION *River Right Looking Downstream*

RIPARIAN WIDTH L R (Per Bank)	FLOOD PLAIN QUALITY (Check 2 Most Predominant)		BANK EROSION L R (Per Bank)
□ □-EXTENSIVE >100m [5]	□□-FOREST, SWAMP [3]	□□-URBAN [1]	□□-NONE [3]
□ □-WIDE 50-100m [4]	□□-OPEN PASTURE [1]	□☒-ROWCROP [1]	☒☒-LITTLE [4]
□ □-MODERATE 10-50m [3]	□□-OLD FIELD [3]	□□-SHRUB [4]	□□-MODER.[3]
☒ ☒-NARROW 5-10m [2]	☒□-RESIDENTIAL,PARK [2]		□□-HEAVY [2]
□ □-VERY NARROW 1-5m [1]	□□-CONSERV. TILLAGE [2]		□□-SEVERE [1]
□ □-NONE [0]	□□-FENCED PASTURE [2]		

COMMENTS:____

9 RIPARIAN

5] POOL/GLIDE AND RIFFLE/RUN QUALITY

MAX. DEPTH (Check 1)	POOL COVER (Check 1)	OVERALL CURRENT VELOCITY (Check All That Apply)		MORPHOLOGY (Check 1)
☒->1m [3]	□-EXTENSIVE [3]	□-TORRENTIAL[-1]	□-EDDIES[1]	□-POOL WIDTH > RIFFLE WIDTH [2]
□-0.7-1m [2]	☒-MODERATE [2]	□-FAST[1]	□-INTERSTITIAL[-1]	☒-POOL WIDTH = RIFFLE WIDTH [1]
□-0.4-0.7m [1]	□-SPARSE [1]	☒-MODERATE [1]		□-POOL WIDTH < RIFFLE W. [0]
□-<0.4m [0]	□-NEARLY ABSENT [0]	□-SLOW [1]		
		□-INTERMITTENT[-2]		

□-NO POOL[0] COMMENTS:____

RIFFLE/RUN DEPTH	RIFFLE/RUN SUBSTRATE	RIFFLE/RUN SUBSTRATE QUALITY
□-GENERALLY <10 cm [1]	□-STABLE (Cobble, Boulder) [1]	□-EMBEDDED [0]
☒-GENERALLY >10 cm,MAX<50 [2]	☒-UNSTABLE (Gravel, Sand) [0]	☒-NOT EMBED. [1]
□-GENERALLY >10 cm,MAX>50 [3]		
□-NO RIFFLE[0]		

10 POOL/ RIFFLE

6] Gradient (ft/mi): ____ 5'/mi
7] Drainage area (sq.mi.): ____

6 GRADIENT 12 DRAINAGE

Invertebrate and Freshwater Mussel Data

Mussels collected during the study

	Site number											
	1	2	3	4	5	6	7	8	9	10	11	12
Actinonaias ligamentina			3-L									
Amblema plicata		1-L	WD									
Anodontoides ferussacianus						WD	1-FD	1-FD				
Elliptio dilatata			WD									
Fusconaia flava	WD											
Lampsilis siliquoidea		1-L										2-L
Lasmigona complanata	1-L	3-L	1-L									3-L
Lasmigona costata	1-FD		1-L									
Pleurobema clava			WD									
Pyganodon grandis	1-L	8-L	WD				1-L	1-FD	2-FD			3-FD
Strophitus undulatus									1-FD			
Toxolasma parvis									1-FD			

L= live
FD = fresh dead
WE = weathered dead

Table 4.
Rapid Bioassessment Results - Mississinewa River Watershed
August 2003

	Site #					
	1	2	3	4	5	6
Chironomidae (Midges)						
Polypedilum convictum	1	1	1	33	3	2
P. fallax				2		
P. illinoense				8		
Glyptotendipes lobiferus						
Dicrotendipes nervosus				1		
D. neomodestus		1				
Cryptochironomus fulvus	1	1	1	1	1	1
Endochironomus spp.	6				2	
Microtendipes caelum		1	2			
Omisus spp.						
Goeldichironomus devineyae						
Ablabesmyia mallochi		3	2	40	4	6
Orthocladius obumbratus		1	1	1		1
Parametriocnemus lundbecki				2		
Cricotopus spp.		4				
Thienemanniella xena						
Cladotanytarus spp.						
Rheotanytarsus spp.						
Tanytarsus guerulus						
Empididae (Danceflies)					1	
Simuliidae (Blackflies)			7	1	2	3
Tipulidae (Craneflies)						
Tipula sp.	1					
Tabanidae (Deerflies)						1
Ephydridae (Shoreflies)	1					
Ephemeroptera (Mayflies)						
Heptagenia sp.			1			
Baetis intercalaris	4	13	29		11	8
B. flavistriga	28	15	6		4	8
Stenacron interpunctatum	1	2	8		3	
Stenonema exiguum		1				
S. pulchellum		3	8			
S. mediopunctatum						
S. femoratum	1					
Caenis spp.			1			9
Tricorythodes spp.		1				
Isonychia sayi			1			
Siphloneurus spp.						

Table 4 (continued)
Rapid Bioassessment Results - Mississinewa River Watershed
August 2003

	Site # 1	2	3	4	5	6
Trichoptera (Caddisflies)						
Cheumatopsyche spp.	13	11	9		20	41
Hydropsyche betteni					3	2
Ceratopsyche bifida	1	12	3		7	
C. sparna					5	
Chimarra obscura		1				
Lepidoptera (Aquatic moths)	1					
Megaloptera (Dobsonflies)						
Corydalus cornutus		2				
Odonata (Dragonflies)						
Boyeria spp.						
Macromia spp.	1					
Argia apicalis						
Coleoptera (Beetles)						
Stenelmis crenata	28	23	14		30	9
Dubiraphia vittata						
Optioservus sp.	4				1	8
Macronychus glabratus						
Psephenus herricki	2	4	4		4	
Berosus larvae	1		1			
Isopoda (Pillbugs)						
Caecidotea spp.	1			1		1
Gastropoda (Snails)				2		
Pelycepoda (Clams)						
Sphaerium spp.				2		
Corbicula fluminea						
Hirudinea (Leeches)				5		
Oligochaeta (Worms)						
Lumbricidae	1					
Decapoda (Crayfish)						
Orconectes sp.	1		1	1		
Total	100	100	100	100	100	100

Table 4 (cont.).
Rapid Bioassessment Results - Mississinewa River Watershed

	Site # 7	8	9	10	11	12	13
Chironomidae (Midges)							
Polypedilum convictum	5	3	22	4	5	12	6
P. fallax		1				2	
P. illinoense	1		8		1	2	
Glyptotendipes lobiferus			2				
Dicrotendipes nervosus				2		2	
D. neomodestus							
Cryptochironomus fulvus		1				2	
Endochironomus spp.				4			
Paratendipes spp.		1					
Microtendipes caelum						6	
Omisus spp.				20			
Goeldichironomus devineyae						2	
Ablabesmyia mallochi	7	27	9	6	6	10	
Orthocladius obumbratus					5		2
Parametriocnemus lundbecki		1					
Cricotopus spp.							
Thienemanniella xena							
Cladotanytarus spp.				2			
Rheotanytarsus spp.							
Tanytarsus guerulus	2						
Empididae (Danceflies)							
Simuliidae (Blackflies)	12				18		2
Tipulidae (Craneflies)							
Tipula sp.							3
Tabanidae (Deerflies)						1	
Ephydridae (Shoreflies)							
Ephemeroptera (Mayflies)							
Hexagenia sp.				1			
Baetis intercalaris	5		1	7	4	3	12
B. flavistriga	6	7		9	31		3
Stenacron interpunctatum	1	18	3	1			
Stenonema exiguum							
S. pulchellum						1	
S. mediopunctatum							1
S. femoratum	1		3	1			
Caenis spp.	3			28		6	
Tricorythodes spp.							
Isonychia sayi							1
Siphloneurus spp.						1	1

Table 4 (continued)
Rapid Bioassessment Results - Mississinewa River Watershed
August 2003

	Site # 7	8	9	10	11	12	13
Trichoptera (Caddisflies)							
Cheumatopsyche spp.	34	17	18		6	35	3
Hydropsyche betteni		1					5
Ceratopsyche bifida							15
C. sparna		2					5
Chimarra obscura							
Lepidoptera (Aquatic moths)							
Megaloptera (Dobsonflies)							
Corydalus cornutus							
Odonata (Dragonflies)							
Boyeria spp.					1		
Macromia spp.							
Argia apicalis							
Coleoptera (Beetles)							
Stenelmis crenata	21	16	7		22	14	27
Dubiraphia vittata				5			
Optioservus sp.	3	22					10
Macronychus glabratus							
Psephenus herricki							3
Berosus larvae				2			
Isopoda (Pillbugs)							
Caecidotea spp.			8	2		1	
Gastropoda (Snails)			4	3			1
Pelycepoda (Clams)							
Sphaerium spp.							
Corbicula fluminea				1			
Hirudinea (Leeches)							
Oligochaeta (Worms)							
Lumbricidae							
Decapoda (Crayfish)							
Orconectes sp.							
Total	100	100	100	100	100	100	100

Mississinewa watershed benthic data sheet 2003

Site Name Mississinewa at Ridgeville Site Number 1
Date collected 7/29/03 Date subsampled ~~7-29~~-03 10/27/03 mw

Hydropsychidae 卌 卌 1111 Cheumatopsyche 卌 卌 111
Ceratopsyche bifida 1

Philopotamidae

Baetidae 卌 卌 卌 卌 卌 卌 11 B. flavistriga 卌 卌 卌 卌 11
B. intercalaris 1111

Caenidae

Heptageniidae 1111 Stenacron 1
Stenonema femoratum 1
Stenonema sp 11

Oligoneuridae

Elmidae
Stenelmis 卌 11

adults 卌 卌 卌 卌 (Stenelmis). all Stenelmis sexlineata (?)
Other Elmidae Optioservus 1111
Psephenidae 11
Hydrophilidae 1
Simuliidae

Tipulidae 1

Chironomidae 卌 111

Other Diptera Ephydridae 1

Megaloptera

Other misc. CRAYFISH 1
Odonata - Macromia ~~Cordulegastridae~~ 1 (in container with crayfish
Isopod 1
Oligochaete 1
~~Ephydridae 1~~
Lepidoptera 1

Mississinewa watershed benthic data sheet 2003

Site Name Mississinewa - middle Site Number 2
Date collected 7-31-03 Date subsampled 11/27/03 MM

Hydropsychidae 卌 卌 卌 卌 ||| } Ceratopsyche bifida 卌 卌
Cheumatopsyche 卌 卌 |

Philopotamidae | Chimarra

Baetidae 卌 卌 卌 卌 卌 ||| }
B. flavistriga 卌 卌 卌
B. intercalaris 卌 卌 |||

Caenidae

Heptageniidae 卌 | } Stenonema exiguum | S. pulchellum |||
Stenacron ||

Oligoneuridae

Tricorythidae |

Elmidae

Stenelmis 卌 卌 卌 |

adults 卌 ||

Other Elmidae

Psephenidae ||||

Simuliidae

Tipulidae

Chironomidae 卌 卌 ||

Other Diptera

Megaloptera 2 Corydalus

Other misc.

Mississinewa watershed benthic data sheet 2003

Site Name Mississinewa at Albany Site Number 3
Date collected 7/30/03 Date subsampled 10/24/03 mw

Hydropsychidae 𝍸 𝍸 || } Cheumatopsyche 𝍸 ||||
Ceratopsyche bifida |||

Philopotamidae

Baetidae 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 | } B. intercalaris 𝍸 𝍸 𝍸 𝍸
B. flavistriga 𝍸 |

Tricorythodes
~~Caenidae~~ |

Heptageniidae 𝍸 𝍸 𝍸 || } Stenacron 𝍸 |||
Stenonema pulchellum 𝍸 |||
Heptagenia |

Oligoneuridae |

Hydrophilidae |
Elmidae
Stenelmis 𝍸 𝍸 ||

adults ||
Other Elmidae

Psephenidae ||||

Simuliidae 𝍸 ||

Tipulidae

Chironomidae 𝍸 ||

Other Diptera

Megaloptera

Other misc. CRAYFISH |

Mississinewa watershed benthic data sheet 2003

Site Name Fetid Creek Site Number 4
Date collected 7-29-03 Date subsampled 10/21/03 mmn

Hydropsychidae

Philopotamidae

Baetidae

Caenidae

Heptageniidae

Oligoneuridae

Elmidae
Stenelmis

adults
Other Elmidae

Simuliidae |

Tipulidae

Chironomidae ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~
~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ |||

Other Diptera

Megaloptera

Other misc. Crayfish |
Leech ~~||||~~
Isopod |
Gastropods ||
Sphaeriidae ||

Mississinewa watershed benthic data sheet 2003

Site Name Bear Creek Site Number 5
Date collected 7-30-03 Date subsampled 10/24/03 mm

Hydropsychidae 卌 卌 卌 卌 卌 卌 卌 37 H. betteni |||
Cheumatopsyche = ~~[illegible]~~ 卌卌卌卌 卌 ~~H. [illegible]~~ 卌
Ceratopsyche bifida 卌 || C. sparna
Philopotamidae

Baetidae 卌 卌 卌 — B. intercalaris 卌 卌 |
B. flavistriga ||||

Caenidae

Heptageniidae ||| Stenacron |||

Oligoneuridae

Elmidae
Stenelmis 卌 卌 卌 ||||

adults 卌 卌 |
Other Elmidae Optioservus |

Psephenidae ||||
Simuliidae ||

Tipulidae

Chironomidae 卌 卌

Other Diptera

Megaloptera

Other misc.

Mississinewa watershed benthic data sheet 2003

Site Name Heuss Ditch Site Number 6
Date collected 7/30/03 Date subsampled 10\20\03 MWK

Hydropsychidae ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ |||
Cheumatopsyche 41
H. bettoni 2
Philopotamidae

Baetidae ~~||||~~ ~~||||~~ ~~||||~~ | 13 B. intercalaris ~~||||~~ |||
B. flavistriga ~~||||~~ ||||

Caenidae ~~||||~~ ||||

Heptageniidae

Oligoneuridae

Elmidae
Stenelmis optioservus adults ~~||||~~ |

Elmidae adults ~~||||~~ ~~||||~~ ~~||||~~ Stenelmis adults ~~||||~~ ||||
Other Elmidae larvae optioservus ||

Simuliidae |||

Tipulidae |

Chironomidae ~~||||~~ ~~||||~~

Other Diptera

Megaloptera

Other misc. Isopod 1

Mississinewa watershed benthic data sheet 2003

Site Name Brush Creek Site Number 7
Date collected 7/30/03 Date subsampled 10/23/03 MNK

Hydropsychidae all Cheumatopsyche

Philopotamidae

Baetidae B. intercalaris
B. flavistriga

Caenidae

Heptageniidae Stenonema femoratum

Oligoneuridae

Elmidae
Stenelmis

adults – Optioservus
Other Elmidae – Stenelmis

Simuliidae

Tipulidae

Chironomidae

Other Diptera

Megaloptera

Other misc.

Mississinewa watershed benthic data sheet 2003

Site Name Elkhorn Creek　　Site Number 8　dupl. collected GRB
Date collected 7/30/03　　Date subsampled 10/28/03 MM

Hydropsychidae 𝍸 𝍸 𝍸 𝍸 } 20　H. bettenii 1　~~H. simulans~~ 11　C. sparna　Cheumatopsyche ~~8~~ 17

Philopotamidae

Baetidae 𝍸 || 7　B. flavistriga 𝍸 ||　B. intercalaris 0

Caenidae

Heptageniidae |　Stenacron

Oligoneuridae

Elmidae
Stenelmis 𝍸 |||

adults 𝍸 |||
Other Elmidae Optioservus 𝍸 𝍸 𝍸 𝍸 ||

Simuliidae

Tipulidae

Chironomidae 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸 ||||

Other Diptera

Megaloptera

Other misc.

Mississinewa watershed benthic data sheet 2003

Site Name Elkhorn Creek   Site Number 8   dupl collected MMK
Date collected 7/30/03   Date subsampled 10/27/03

Hydropsychidae 卌 卌 卌 | | H. betteni ||
C. bifida | H. sicilans ~~卌~~ ||| C. sparna
Philopotamidae   Cheumatopsyche 卌 |

Baetidae 卌 → B. flavistriga 卌

Caenidae

Heptageniidae

Oligoneuridae

Elmidae
Stenelmis 卌 卌 卌

adults 卌 卌 卌 |||
Other Elmidae Optioservus 卌 卌 卌 ||

Simuliidae

Tipulidae |

Chironomidae 卌 卌 卌 卌 |||

Other Diptera Hemerodromia pupa | Empididae

Megaloptera

Other misc.
Gastropoda ||
Sphaeriidae |

Mississinewa watershed benthic data sheet 2003

Site Name Mud Creek Site Number 9
Date collected 7-29-03 Date subsampled 11-20-03 mmr

Hydropsychidae ~~||||~~ ~~||||~~ ~~||||~~ ||| all Cheumatopsyche

Philopotamidae

Baetidae | B. intercalaris

Caenidae

Heptageniidae ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ 13 Stenacron ~~||||~~ ~~||||~~ ~~||||~~ |||
~~Heptagenia~~
Stenonema femoratum |||

Oligoneuridae

Elmidae
Stenelmis ~~||||~~

adults ||
Other Elmidae

Simuliidae

Tipulidae

Chironomidae ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ |

Other Diptera

Megaloptera

Other misc. CRAYFISH ||||

150 PODS ~~||||~~ |||

Mississinewa watershed benthic data sheet 2003

Site Name Days Creek Site Number 10
Date collected 7-29-03 Date subsampled 10-22-03

Hydropsychidae

Philopotamidae

Baetidae ~~||||~~ ~~||||~~ ~~||||~~ 13 B. intercalaris ~~||||~~ || B. flavistriga ~~||||~~ ||||
Caenis latipennis ~~||||~~ ~~||||~~
C. tardata ~~||||~~ ~~||||~~ |||

Caenidae ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ |||

Heptageniidae |||| Stenacron |||
Stenonema femoratum |

Oligoneuridae
Ephemeridae | Hexagenia
Elmidae
Stenelmis

adults
Other Elmidae Dubiraphia larvae |
adults |||| (Dubiraphia)
Coleoptera - Hydrophilidae ||
Simuliidae

Tipulidae

Chironomidae ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ||

Other Diptera

Megaloptera

Other misc. Corbicula |
CRAYFISH |||
Isopod ||

Mississinewa watershed benthic data sheet 2003

Site Name Platt N.barger Site Number 11
Date collected 7-29-03 Date subsampled 10/23/03 MMK

Hydropsychidae 6 all Cheumatopsyche

Philopotamidae

Baetidae 34 B. intercalaris IIII
B. flavistriga ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~

Caenidae

Heptageniidae 1 Stenacron

Oligoneuridae

Elmidae
Stenelmis 16

adults 6 Optioservus 1
Stenelmis 5
Other Elmidae 1 Optioservus larva

Simuliidae 18

Tipulidae

Chironomidae 17

Other Diptera

Megaloptera

Other misc. Odonata - Aeshnidae 1 Boyeria

Mississinewa watershed benthic data sheet 2003

Site Name Halfway Creek Site Number 12
Date collected 7/29/03 Date subsampled 10/22/03 mmh

Hydropsychidae ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ?
Cheumatopsyche = all of them

Philopotamidae

Baetidae |||| — B. intercalaris |||
Siphlonuridae | — Siphlonurus

Caenidae ~~||||~~ |

Heptageniidae | (early instar) S. pulchellum

Oligoneuridae

Elmidae
Stenelmis ~~||||~~ |

adults ~~||||~~ |||
Other Elmidae

Simuliidae

Tipulidae

Chironomidae ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ~~||||~~ ||||

Other Diptera Tabanidae |

Megaloptera

Other misc. Isopod |

Mississinewa watershed benthic data sheet 2003

Site Name Stony Creek   Site Number Reference site (13)
Date collected 7-29-03   Date subsampled 10/21/03

Hydropsychidae 𝍸 𝍸 𝍸 𝍸 𝍸 ||| H. bettoni 𝍸   ~~s~~ 𝍸   C. sparna
Ceratopsyche bifida 𝍸 𝍸 𝍸
Cheumatopsyche |||

Philopotamidae

B. intercalaris 𝍸 𝍸 ||
Baetidae 𝍸 𝍸 𝍸
B. flavistriga ||||
Siphlonuridae 1 - S. [illegible]

Caenidae

Heptageniidae | Stenonema mediopunctatum

Oligoneuridae |

Elmidae
Stenelmis 𝍸 𝍸 𝍸 𝍸 |||

adults ||||
Other Elmidae Optioservus 𝍸 𝍸

Psephenidae |||
Simuliidae ||

Tipulidae |||

Chironomidae 𝍸 |||

Other Diptera

Megaloptera

Other misc.
crayfish |

Aquatox Model Results

Site Name Missi Save to Library

Site Data:

Stream Data

Parameter	Value	Unit	References:	
Max Length (or reach)	16	km	arbitrary	
Vol. (only used if copied into water volume state var.)	40000	m^3	calc.	
Surface Area	80000	m^2	calc. from mean width = 5	
Mean Depth	0.5	m	prof. judgment	
Maximum Dep Save to Library		m	file str.sd2 (SAIC)	
Ave. Epilimnetic Temp.	15	°C	file efpc_chm.sd2 (ORNL)	
Epilimnetic Temp. Range	10	°C	annual air temp range (radiate-search.c	
Ave. Hypolimnetic Temp.	15	°C		
Hypolimnetic Temp. Range	10	°C		
Latitude (Neg. in So. Hemisphere)	40	deg.	USGS Sta. 03538250	
Average Light	361	Ly / d	calc. from kwh (radiate-search.cgi)	
Annual Light Range	361	Ly / d	calc. from kwh ((radiate-search.cgi)	
Total Alkalinity Save to Library	200	mg/L	file efpc_chm.sd2 (ORNL	(Parameter Not Currently Utilized by AQUATOX)
Hardness as $CaCO^3$	300	mg $CaCO_3$ /L	file efpc_chm.sd2 (ORNL	(Parameter Not Currently Utilized by AQUATOX)
Sulfate Ion Conc.	10	mg/L	ave. for sed. terrenes, III	(Parameter Not Currently Utilized by AQUATOX)
Total Dissolved Solids	400	mg/L	ave. for N. American rive	(Parameter Not Currently Utilized by AQUATOX)
Limnocorral Wall Area (limnocorral only)	0	m^2		
Mean Evaporation	24	in. / year		

tate Variable Name	Init. Cond.	Units	Org. Tox. I.C.	Tox. Units
nmonia	0.1	mg/L		
itrate	10	mg/L		
hosphate	0.3	mg/L		
arbon dioxide	0.7	mg/L		
xygen	9	mg/L		
ot. Susp. Solids	10	mg/L		
abile sed. detritus	2	g/sq.m		
efrac. sed. detritus	4	g/sq.m		
detr diss	3.325	mg/L		
detr diss	3.325	mg/L		
detr part	1.425	mg/L		
detr part	1.425	mg/L		
uried labile detritus	2	Kg/cu.m		
uried refrac. detritus	2	Kg/cu.m		
iatoms: [Periphyton, Diatoms]	0.5	mg/L		
reens: [Periphyton, Greens]	5	mg/L		
acrophytes: [Myriophyllum]	1	mg/L		
etritivorous invertebrate: [Amphipod]	0.8	mg/L		
erbivorous invertebrate: [Mayfly]	0.8	mg/L		
ottom fish: [Stoneroller]	1	mg/L		
orage fish: [Shiner]	2.5	mg/L		
mall game fish: [Largemouth Bass, YOY]	0.5	mg/L		
arge game fish: [Largemouth Bass, Lg]	3.5	mg/L		

Mississinewa River - Before BMP Implementation

DATE	NH4	NO3	PO4	CO2	OXYGEN	SUSP_SANI	SUSP_SILT	SUSP_CLA'	L_DETR_SE	R_DETR_SI	L_DETR_DI
01/01/03	0.100	10.000	0.300	0.700	14.000	0.000	30.000	0.000	2.000	4.000	3.325
01/01/03	0.100	10.000	0.300	0.700	14.000	0.000	30.000	0.000	2.000	4.000	3.325
01/29/03	0.515	4.290	0.268	0.983	11.010	0.267	32.714	288.202	0.901	0.875	3.635
02/28/03	0.161	13.568	0.417	0.989	10.569	0.350	31.318	0.000	1.334	1.374	3.619
03/30/03	0.116	6.229	0.114	0.970	10.064	0.442	30.639	0.000	1.259	1.291	3.577
04/29/03	0.105	7.703	0.183	0.986	9.439	0.549	30.301	0.000	1.573	1.606	3.533
05/29/03	0.127	2.737	0.278	1.205	8.622	0.433	30.919	0.000	2.684	2.764	3.697
06/28/03	0.200	2.059	0.403	1.312	8.032	0.283	32.754	0.000	2.644	2.805	3.812
07/28/03	0.327	3.543	0.566	1.326	7.879	0.181	38.068	0.000	2.042	2.187	3.931
08/27/03	0.402	4.345	0.822	1.139	8.106	0.144	42.448	0.000	1.886	1.996	3.845
09/26/03	0.354	3.665	0.809	1.014	8.679	0.152	40.763	0.000	1.764	1.890	3.757
10/26/03	0.272	8.076	0.524	0.949	9.328	0.178	37.446	0.000	1.394	1.520	3.717
11/25/03	0.223	6.329	0.274	0.950	10.108	0.203	35.480	0.000	0.871	0.916	3.695
12/25/03	0.293	5.573	0.225	1.028	10.678	0.209	35.200	0.000	1.245	1.326	3.755
01/24/04	0.475	4.496	0.257	0.980	11.004	0.257	32.991	0.000	0.160	0.166	3.661
02/23/04	0.239	11.613	0.387	0.979	10.682	0.337	31.424	0.000	1.282	1.320	3.612
03/24/04	0.118	7.927	0.180	0.967	10.167	0.427	30.709	0.000	1.192	1.228	3.579
04/23/04	0.104	7.192	0.161	0.973	9.556	0.530	30.310	0.000	1.451	1.483	3.534
05/23/04	0.120	3.851	0.257	1.146	8.765	0.473	30.643	0.000	2.394	2.459	3.653
06/22/04	0.174	1.979	0.370	1.242	8.161	0.316	32.017	0.000	2.104	2.342	3.758
07/22/04	0.281	3.069	0.517	1.277	7.921	0.200	36.175	0.000	2.250	2.395	3.873
08/21/04	0.393	4.277	0.772	1.157	8.064	0.147	41.892	0.000	1.879	1.996	3.853
09/20/04	0.366	3.842	0.824	1.029	8.557	0.149	41.267	0.000	1.820	1.940	3.769
10/20/04	0.285	6.913	0.588	0.955	9.214	0.172	37.990	0.000	1.471	1.588	3.716
11/19/04	0.229	7.135	0.318	0.940	9.969	0.199	35.790	0.000	0.195	0.208	3.702
12/19/04	0.274	5.534	0.225	1.018	10.588	0.209	35.200	0.000	1.242	1.323	3.747
01/18/05	0.429	4.759	0.244	0.991	10.964	0.245	33.370	0.000	1.200	1.257	3.675
02/17/05	0.330	9.364	0.353	0.976	10.790	0.321	31.587	0.000	1.278	1.338	3.611
03/19/05	0.121	9.325	0.234	0.966	10.278	0.412	30.815	0.000	1.180	1.210	3.585
04/18/05	0.106	6.769	0.142	0.965	9.673	0.513	30.334	0.000	1.379	1.406	3.537
05/18/05	0.116	4.814	0.241	1.119	8.905	0.500	30.530	0.000	2.183	2.235	3.612
06/17/05	0.159	1.959	0.348	1.222	8.265	0.338	31.644	0.000	3.273	3.400	3.736
07/17/05	0.259	2.795	0.490	1.272	7.967	0.215	35.308	0.000	2.381	2.537	3.862
08/16/05	0.387	4.227	0.731	1.185	8.015	0.150	41.471	0.000	1.884	1.996	3.866
09/15/05	0.377	3.987	0.836	1.043	8.436	0.146	41.661	0.000	1.871	1.978	3.775
10/15/05	0.299	5.934	0.643	0.962	9.089	0.168	38.498	0.000	1.576	1.683	3.743
11/14/05	0.239	7.812	0.357	0.950	9.806	0.195	36.069	0.000	1.264	1.380	3.709
12/14/05	0.257	5.501	0.225	1.004	10.497	0.209	35.200	0.000	1.224	1.317	3.738
12/31/05	0.311	5.610	0.225	1.038	10.750	0.209	35.200	0.000	1.227	1.319	3.761
Average	0.250	5.867	0.395	1.041	9.656	0.267	34.517	7.390	1.614	1.796	3.689

R_DETR_DI	L_DETR_PA	R_DETR_PA	BURLDETR	BURRDETR	DIATOMS_(	BL_GREEN:	OTH_ALG_(	MACROPH_	D_INVERT	H_INVERT	B_FISH
3.325	1.425	1.425	2.000	2.000	3.000	1.000	3.000	0.500	0.800	0.800	7.000
3.325	1.425	1.425	2.000	2.000	3.000	1.000	3.000	0.500	0.800	0.800	7.000
3.351	1.855	1.518	2.000	2.001	1.139	0.924	5.696	14.546	9.031	4.849	46.230
3.348	1.881	1.566	2.000	2.001	1.192	0.926	1.429	19.440	17.036	8.227	54.905
3.340	1.889	1.599	2.000	2.001	1.706	0.950	3.494	22.057	14.950	11.030	63.553
3.334	1.842	1.584	2.000	2.001	4.491	0.968	5.049	22.679	16.674	16.255	70.399
3.360	2.115	1.655	2.000	2.001	3.828	0.957	4.116	22.099	34.616	38.896	79.652
3.361	2.230	1.642	2.000	2.001	1.489	0.916	1.627	19.675	46.148	83.270	64.856
3.383	2.358	1.644	2.000	2.001	0.905	0.854	1.013	15.560	43.814	102.828	52.588
3.375	2.190	1.564	2.000	2.001	0.826	0.848	0.930	12.587	31.253	74.515	41.140
3.361	2.048	1.525	2.000	2.001	0.654	0.859	0.749	12.050	25.566	44.161	37.184
3.360	1.971	1.524	2.000	2.001	0.494	0.863	0.595	12.909	19.799	23.382	37.851
3.360	1.921	1.530	2.000	2.001	0.511	0.865	0.619	14.084	10.178	11.077	42.641
3.373	2.002	1.558	2.000	2.001	0.588	0.859	0.708	14.597	15.031	6.649	48.787
3.356	2.225	1.851	2.000	2.001	0.775	0.898	0.900	16.176	10.497	5.118	46.878
3.345	1.853	1.550	2.000	2.001	1.147	0.919	1.290	19.161	13.288	5.675	52.334
3.339	1.884	1.595	2.000	2.001	1.614	0.950	2.901	21.744	13.833	8.910	61.349
3.331	1.844	1.585	2.000	2.001	3.837	0.965	4.803	22.797	15.353	13.933	68.531
3.349	2.061	1.643	2.000	2.001	4.329	0.961	4.642	22.293	28.999	30.501	79.900
3.354	2.625	1.984	2.000	2.001	1.803	0.929	1.956	20.473	45.367	68.506	65.286
3.368	2.289	1.632	2.000	2.001	1.048	0.871	1.166	16.438	44.252	96.317	52.808
3.373	2.208	1.573	2.000	2.001	0.835	0.862	0.940	12.946	32.547	79.364	42.045
3.365	2.066	1.529	2.000	2.001	0.709	0.861	0.807	12.013	26.541	48.423	37.359
3.359	1.970	1.520	2.000	2.001	0.550	0.865	0.652	12.667	20.909	26.726	37.294
3.361	2.430	1.987	2.000	2.001	0.465	0.855	0.565	13.858	13.285	13.191	41.403
3.371	1.993	1.555	2.000	2.001	0.584	0.860	0.704	14.566	14.752	7.230	48.016
3.358	1.901	1.541	2.000	2.001	0.790	0.900	0.924	15.681	13.890	5.225	45.762
3.341	1.843	1.540	2.000	2.001	1.092	0.924	1.235	18.550	12.316	5.196	50.320
3.343	1.881	1.593	2.000	2.001	1.542	0.944	2.526	21.395	13.672	8.134	59.323
3.330	1.847	1.587	2.000	2.001	3.313	0.961	4.575	22.801	14.769	12.829	67.031
3.345	1.985	1.624	2.000	2.001	4.559	0.962	4.875	22.309	25.643	26.409	80.366
3.352	2.117	1.616	2.000	2.001	2.398	0.940	2.604	20.946	45.866	60.463	66.774
3.374	2.270	1.636	2.000	2.001	1.146	0.898	1.271	17.077	44.817	94.439	53.943
3.374	2.233	1.583	2.000	2.001	0.839	0.844	0.944	13.294	34.108	85.305	43.249
3.363	2.082	1.531	2.000	2.001	0.748	0.844	0.848	12.029	27.352	52.710	37.668
3.375	2.011	1.537	2.000	2.001	0.586	0.849	0.687	12.483	21.869	29.687	36.828
3.361	1.948	1.530	2.000	2.001	0.489	0.868	0.599	13.672	16.944	14.563	40.330
3.370	1.980	1.551	2.000	2.001	0.581	0.873	0.701	14.531	14.002	7.459	47.128
3.374	2.010	1.560	2.000	2.001	0.590	0.873	0.710	14.612	15.213	6.242	49.343
3.356	2.018	1.595	2.000	2.001	1.543	0.904	1.945	16.097	22.200	31.777	50.386

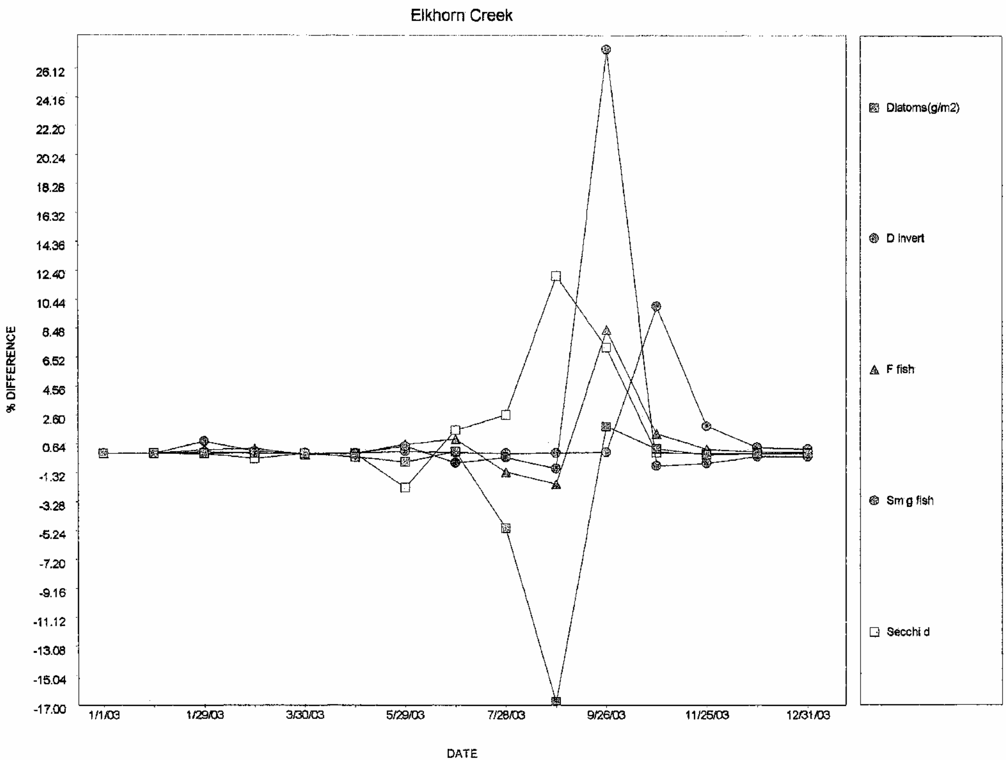
F_FISH	SM_G_FISH	LG_G_FISH	WATER_VC	INFLOWH2(	SECCHI_D	CHLOROPH	PH	LIGHT	TEMP	WIND	BED_DEPTH_
7.000	5.000	3.500	40000.000	0.000	0.325	11.689	7.700	183.156	10.678	2.867	0.500
7.000	5.000	3.500	40000.000	0.000	0.325	11.689	7.700	183.156	10.678	2.867	0.500
43.286	20.792	33.221	13931.286	38415.977	0.076	10.801	7.700	189.490	10.005	3.906	0.461
48.504	24.985	46.865	21501.042	79060.291	0.235	10.822	7.700	240.596	10.547	2.279	0.200
54.857	31.035	59.165	32326.643	*************	0.230	11.106	7.700	323.963	12.253	2.067	0.200
61.634	36.358	67.208	48937.266	*************	0.230	11.320	7.700	417.255	14.676	4.302	0.200
65.816	45.288	79.138	29866.431	*************	0.228	11.192	7.700	495.473	17.183	2.840	0.200
50.029	30.052	68.955	14673.983	36370.001	0.226	10.707	7.700	537.659	19.121	3.906	0.200
40.069	22.180	53.722	7614.126	12381.943	0.214	9.978	7.700	532.510	19.982	2.279	0.200
31.966	16.180	38.795	5721.264	8417.861	0.204	9.911	7.700	481.404	19.542	2.068	0.200
29.936	14.486	32.430	6181.551	9835.768	0.213	10.036	7.700	398.036	17.915	4.301	0.200
31.499	16.365	31.051	7695.248	14245.511	0.225	10.088	7.700	304.745	15.528	2.840	0.200
35.787	17.711	37.681	9256.724	19202.339	0.231	10.114	7.700	226.527	13.002	3.906	0.200
41.279	20.266	47.260	9616.914	20133.611	0.230	10.042	7.700	184.341	10.998	2.279	0.200
39.759	19.919	45.039	13198.183	35191.124	0.234	10.496	7.700	185.240	10.043	6.683	0.200
45.096	23.796	48.587	20259.814	71943.852	0.235	10.744	7.700	229.334	10.368	2.239	0.200
52.987	29.664	57.683	30293.038	*************	0.231	11.103	7.700	308.708	11.904	4.485	0.200
60.037	35.027	65.250	45753.472	*************	0.229	11.282	7.700	402.093	14.248	4.219	0.200
67.233	49.543	74.351	35285.885	*************	0.228	11.235	7.700	484.468	16.788	2.722	0.200
50.932	30.883	69.245	17541.876	50455.706	0.225	10.854	7.700	533.759	18.862	6.684	0.200
40.267	22.654	54.321	8858.736	16279.967	0.220	10.181	7.700	536.760	19.927	2.239	0.200
32.574	16.762	40.644	5878.369	8805.002	0.205	10.071	7.700	492.666	19.705	4.485	0.200
29.842	14.492	32.925	6022.452	9439.210	0.211	10.070	7.700	413.292	18.254	4.219	0.200
30.853	14.929	32.164	7370.256	13276.455	0.223	10.116	7.700	319.907	15.953	2.722	0.200
34.879	17.123	37.027	8957.526	18203.871	0.227	9.994	7.700	237.532	13.404	6.685	0.200
40.609	19.922	45.914	9616.914	20133.611	0.230	10.047	7.700	188.241	11.271	2.239	0.200
38.964	19.376	44.895	12273.436	31329.455	0.236	10.524	7.700	181.907	10.136	4.402	0.200
43.337	22.542	46.876	18726.263	63381.966	0.236	10.795	7.700	217.149	10.199	3.052	0.200
51.209	28.411	55.378	28540.882	*************	0.231	11.034	7.700	290.936	11.515	2.322	0.199
58.628	33.970	63.737	42997.794	*************	0.229	11.232	7.700	383.496	13.742	1.788	0.199
68.526	41.664	83.564	39433.275	*************	0.229	11.243	7.700	470.028	16.297	2.323	0.199
52.748	32.487	71.337	19723.295	62159.677	0.228	10.983	7.700	527.347	18.514	4.402	0.199
41.212	23.546	56.334	9793.294	19541.281	0.222	10.501	7.700	540.093	19.812	3.052	0.199
33.462	17.494	42.832	6006.685	9128.101	0.206	9.863	7.700	504.851	19.854	2.323	0.199
29.876	14.587	33.538	5891.925	9104.625	0.209	9.861	7.700	431.064	18.628	1.788	0.199
30.322	17.112	29.200	7087.881	12472.997	0.221	9.920	7.700	338.504	16.455	2.322	0.199
34.096	16.989	35.079	8703.053	17371.865	0.229	10.143	7.700	251.971	13.901	4.403	0.199
39.829	19.569	43.959	9616.914	20133.611	0.230	10.210	7.700	194.653	11.635	3.052	0.199
41.765	20.495	48.650	9616.914	20133.611	0.230	10.203	7.700	181.437	10.710	3.383	0.199
41.992	23.299	47.718	18327.452	63852.635	0.226	10.569	7.700	347.276	14.724	3.357	0.222

Mississinewa River - After BMP Implementation

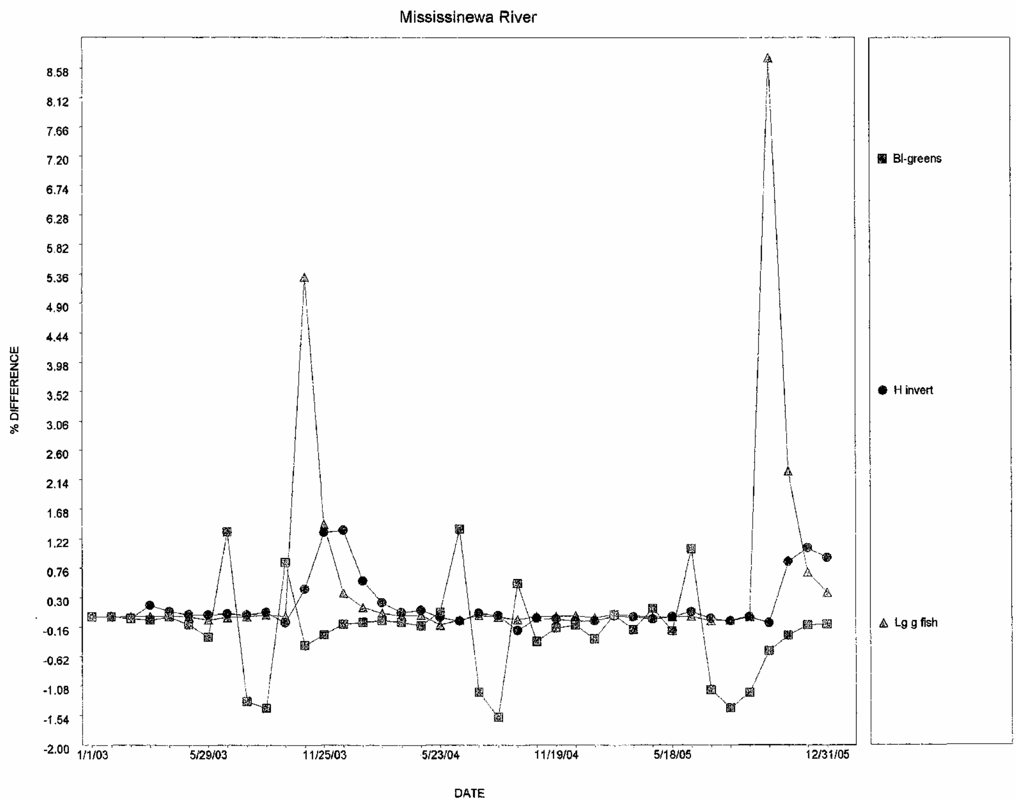
DATE	NH4	NO3	PO4	CO2	OXYGEN	SUSP_SANI	SUSP_SILT	SUSP_CLA'	L_DETR_SE	R_DETR_SE	L_DETR_DI
01/01/03	0.100	10.000	0.300	0.700	14.000	0.000	30.000	0.000	2.000	4.000	3.325
01/01/03	0.100	10.000	0.300	0.700	14.000	0.000	30.000	0.000	2.000	4.000	3.325
01/29/03	0.235	1.884	0.109	0.983	11.010	0.267	32.715	288.061	0.903	0.877	3.636
02/28/03	0.072	6.656	0.197	0.989	10.570	0.350	31.321	0.000	1.335	1.375	3.619
03/30/03	0.054	3.037	0.050	0.970	10.065	0.442	30.665	0.000	1.259	1.292	3.580
04/29/03	0.056	3.817	0.088	0.987	9.439	0.549	30.301	0.000	1.573	1.606	3.533
05/29/03	0.073	1.288	0.132	1.205	8.620	0.433	30.919	0.000	2.685	2.765	3.697
06/28/03	0.100	0.774	0.181	1.311	8.037	0.283	32.754	0.000	2.647	2.808	3.812
07/28/03	0.127	1.023	0.216	1.327	7.874	0.181	38.065	0.000	2.041	2.186	3.931
08/27/03	0.118	1.003	0.301	1.140	8.102	0.144	42.443	0.000	1.884	1.994	3.845
09/26/03	0.100	0.817	0.308	1.013	8.683	0.152	40.785	0.000	1.764	1.890	3.759
10/26/03	0.081	3.339	0.194	0.949	9.318	0.178	37.405	0.000	1.390	1.516	3.707
11/25/03	0.068	2.647	0.087	0.950	10.100	0.203	35.458	0.000	0.866	0.911	3.692
12/25/03	0.106	2.296	0.065	1.028	10.668	0.209	35.200	0.000	1.246	1.327	3.755
01/24/04	0.214	1.964	0.101	0.980	11.004	0.257	32.991	0.000	0.160	0.166	3.661
02/23/04	0.110	5.667	0.180	0.979	10.682	0.337	31.424	0.000	1.282	1.320	3.612
03/24/04	0.054	3.891	0.083	0.967	10.167	0.426	30.709	0.000	1.192	1.228	3.579
04/23/04	0.055	3.560	0.076	0.973	9.547	0.530	30.301	0.000	1.452	1.484	3.533
05/23/04	0.069	1.873	0.123	1.147	8.779	0.473	30.735	0.000	2.402	2.466	3.664
06/22/04	0.088	0.803	0.170	1.238	8.173	0.315	32.058	0.000	2.107	2.344	3.762
07/22/04	0.116	0.957	0.208	1.278	7.916	0.200	36.176	0.000	2.250	2.395	3.873
08/21/04	0.119	1.020	0.281	1.156	8.052	0.147	41.847	0.000	1.878	1.995	3.849
09/20/04	0.103	0.859	0.311	1.027	8.561	0.149	41.252	0.000	1.819	1.939	3.768
10/20/04	0.084	2.702	0.222	0.955	9.213	0.172	37.989	0.000	1.470	1.588	3.716
11/19/04	0.069	3.021	0.106	0.940	9.969	0.199	35.790	0.000	0.195	0.208	3.702
12/19/04	0.097	2.277	0.065	1.018	10.591	0.209	35.200	0.000	1.242	1.323	3.748
01/18/05	0.188	2.054	0.091	0.990	10.944	0.245	33.298	0.000	1.199	1.256	3.667
02/17/05	0.154	4.511	0.161	0.977	10.796	0.321	31.623	0.000	1.278	1.338	3.615
03/19/05	0.055	4.595	0.110	0.966	10.273	0.412	30.787	0.000	1.180	1.210	3.582
04/18/05	0.054	3.350	0.067	0.966	9.689	0.513	30.406	0.000	1.378	1.405	3.545
05/18/05	0.066	2.356	0.116	1.120	8.904	0.500	30.530	0.000	2.183	2.235	3.612
06/17/05	0.082	0.825	0.161	1.222	8.271	0.338	31.650	0.000	3.274	3.400	3.737
07/17/05	0.111	0.909	0.203	1.271	7.959	0.215	35.287	0.000	2.380	2.536	3.859
08/16/05	0.121	1.036	0.265	1.185	8.009	0.150	41.483	0.000	1.883	1.995	3.867
09/15/05	0.106	0.893	0.314	1.044	8.432	0.146	41.660	0.000	1.870	1.977	3.775
10/15/05	0.086	2.161	0.245	0.961	9.088	0.168	38.495	0.000	1.550	1.656	3.716
11/14/05	0.073	3.332	0.123	0.951	9.802	0.194	36.045	0.000	1.264	1.379	3.705
12/14/05	0.088	2.261	0.065	1.004	10.496	0.209	35.200	0.000	1.224	1.317	3.738
12/31/05	0.115	2.315	0.065	1.039	10.750	0.209	35.200	0.000	1.227	1.319	3.761
Average	0.099	2.763	0.165	1.041	9.655	0.267	34.517	7.386	1.614	1.796	3.689

R_DETR_DI	L_DETR_P/	R_DETR_P/	BURLDETR	BURRDETR	DIATOMS_(	BL_GREEN:	OTH_ALG_(	MACROPH_	D_INVERT	H_INVERT	B_FISH
3.325	1.425	1.425	2.000	2.000	3.000	1.000	3.000	0.500	0.800	0.800	7.000
3.325	1.425	1.425	2.000	2.000	3.000	1.000	3.000	0.500	0.800	0.800	7.000
3.351	1.855	1.518	2.000	2.001	1.139	0.924	5.695	14.545	9.031	4.847	46.232
3.349	1.881	1.566	2.000	2.001	1.193	0.925	1.428	19.440	17.064	8.241	54.915
3.343	1.890	1.600	2.000	2.001	1.707	0.950	3.497	22.059	14.951	11.039	63.557
3.334	1.842	1.584	2.000	2.001	4.490	0.967	5.048	22.677	16.678	16.261	70.398
3.360	2.116	1.655	2.000	2.001	3.827	0.954	4.116	22.099	34.649	38.909	79.652
3.361	2.229	1.642	2.000	2.001	1.489	0.928	1.627	19.677	46.163	83.305	64.850
3.383	2.358	1.644	2.000	2.001	0.905	0.842	1.013	15.562	43.810	102.856	52.592
3.374	2.191	1.564	2.000	2.001	0.826	0.836	0.930	12.589	31.246	74.565	41.153
3.364	2.048	1.526	2.000	2.001	0.655	0.866	0.749	12.050	25.553	44.118	37.190
3.355	1.959	1.520	2.000	2.001	0.491	0.859	0.592	12.912	19.809	23.482	37.821
3.358	1.920	1.529	2.000	2.001	0.509	0.863	0.616	14.083	10.228	11.222	42.600
3.373	2.002	1.558	2.000	2.001	0.587	0.858	0.707	14.596	15.065	6.739	48.753
3.356	2.225	1.851	2.000	2.001	0.775	0.897	0.900	16.174	10.510	5.146	46.872
3.345	1.853	1.550	2.000	2.001	1.146	0.919	1.290	19.166	13.298	5.687	52.339
3.339	1.884	1.595	2.000	2.001	1.614	0.949	2.900	21.745	13.837	8.915	61.349
3.330	1.843	1.585	2.000	2.001	3.840	0.964	4.804	22.796	15.360	13.946	68.544
3.360	2.065	1.647	2.000	2.001	4.335	0.962	4.649	22.293	29.045	30.496	79.893
3.360	2.622	1.984	2.000	2.001	1.812	0.941	1.966	20.474	45.362	68.454	65.254
3.368	2.290	1.632	2.000	2.001	1.048	0.861	1.166	16.442	44.269	96.362	52.820
3.370	2.207	1.571	2.000	2.001	0.835	0.848	0.940	12.946	32.528	79.373	42.042
3.365	2.065	1.529	2.000	2.001	0.708	0.866	0.806	12.014	26.509	48.315	37.357
3.359	1.970	1.520	2.000	2.001	0.550	0.862	0.652	12.666	20.903	26.717	37.295
3.361	2.430	1.986	2.000	2.001	0.465	0.853	0.565	13.858	13.281	13.186	41.406
3.371	1.993	1.555	2.000	2.001	0.584	0.858	0.704	14.566	14.751	7.224	48.020
3.351	1.897	1.538	2.000	2.001	0.788	0.897	0.922	15.676	13.885	5.221	45.754
3.345	1.845	1.542	2.000	2.001	1.092	0.924	1.234	18.553	12.318	5.197	50.338
3.340	1.880	1.592	2.000	2.001	1.540	0.942	2.520	21.394	13.676	8.134	59.330
3.338	1.851	1.591	2.000	2.001	3.313	0.962	4.576	22.802	14.766	12.824	67.025
3.346	1.985	1.624	2.000	2.001	4.559	0.960	4.875	22.309	25.642	26.408	80.363
3.352	2.117	1.617	2.000	2.001	2.394	0.950	2.601	20.943	45.874	60.509	66.778
3.372	2.269	1.635	2.000	2.001	1.147	0.888	1.272	17.074	44.800	94.411	53.913
3.375	2.234	1.584	2.000	2.001	0.839	0.832	0.945	13.291	34.081	85.243	43.240
3.363	2.082	1.531	2.000	2.001	0.748	0.834	0.847	12.028	27.341	52.706	37.673
3.356	1.978	1.518	2.000	2.001	0.584	0.844	0.686	12.481	21.754	29.659	36.871
3.358	1.945	1.529	2.000	2.001	0.488	0.865	0.597	13.670	16.976	14.687	40.292
3.370	1.980	1.551	2.000	2.001	0.581	0.872	0.700	14.531	14.048	7.539	47.113
3.374	2.010	1.561	2.000	2.001	0.590	0.872	0.710	14.612	15.252	6.299	49.334
3.356	2.017	1.594	2.000	2.001	1.543	0.902	1.945	16.097	22.203	31.791	50.383

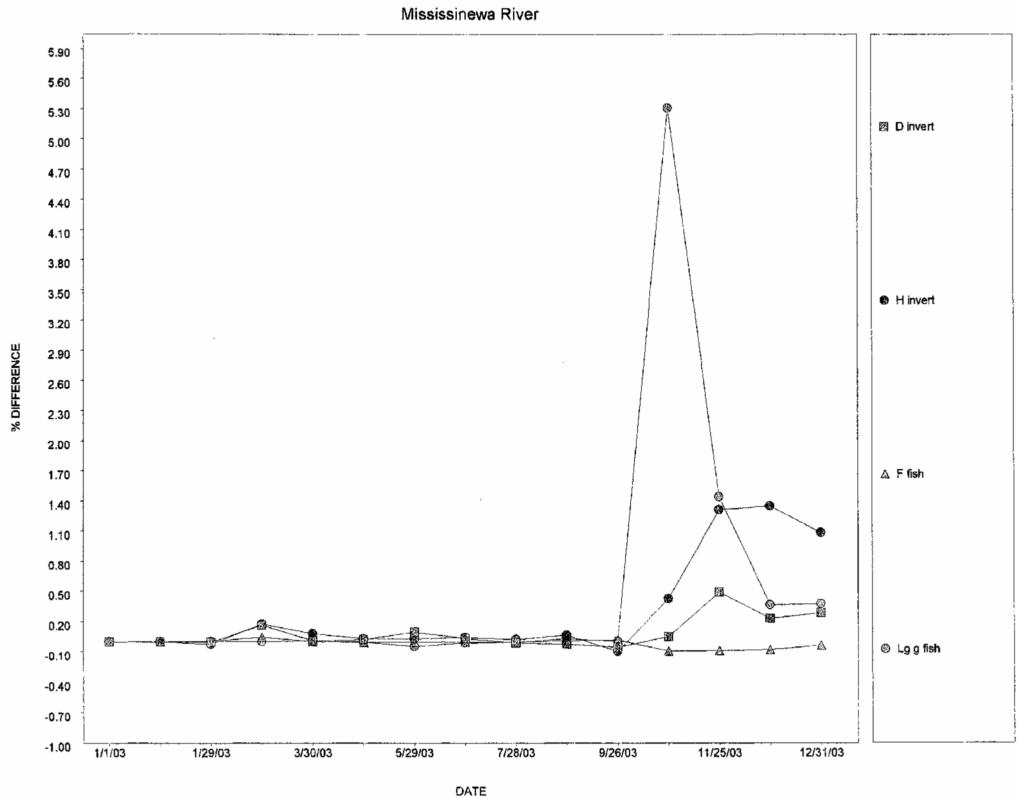
F_FISH	SM_G_FISH	LG_G_FISH	WATER_VC	INFLOWH2(	SECCHI_D	CHLOROPH	PH	LIGHT	TEMP	WIND	BED_DEPTH_
7.000	5.000	3.500	40000.000	0.000	0.325	11.689	7.700	183.156	10.678	2.867	0.500
7.000	5.000	3.500	40000.000	0.000	0.325	11.689	7.700	183.156	10.678	2.867	0.500
43.290	20.792	33.222	13930.040	38417.223	0.076	10.798	7.700	189.490	10.005	3.906	0.463
48.526	24.985	46.866	21499.952	79061.381	0.235	10.816	7.700	240.596	10.547	2.279	0.200
54.859	31.039	59.172	32341.325	*************	0.230	11.105	7.700	323.963	12.253	2.067	0.200
61.632	36.357	67.207	48935.957	*************	0.230	11.306	7.700	417.255	14.676	4.302	0.200
65.814	45.305	79.102	29866.453	*************	0.228	11.156	7.700	495.473	17.183	2.840	0.200
50.029	30.053	68.948	14673.802	36370.181	0.226	10.848	7.700	537.659	19.121	3.906	0.200
40.069	22.180	53.720	7614.422	12381.646	0.214	9.846	7.700	532.510	19.982	2.279	0.200
31.969	16.183	38.807	5722.243	8416.882	0.204	9.770	7.700	481.404	19.542	2.068	0.200
29.941	14.489	32.431	6182.341	9834.978	0.212	10.120	7.700	398.036	17.915	4.301	0.200
31.470	15.285	32.700	7698.888	14241.872	0.225	10.043	7.700	304.745	15.528	2.840	0.200
35.755	17.575	38.223	9254.939	19204.124	0.231	10.085	7.700	226.527	13.002	3.906	0.200
41.246	20.238	47.432	9616.914	20133.611	0.230	10.030	7.700	184.341	10.998	2.279	0.200
39.750	19.915	45.102	13199.180	35190.127	0.234	10.486	7.700	185.240	10.043	6.683	0.200
45.097	23.800	48.610	20259.807	71943.859	0.235	10.737	7.700	229.334	10.368	2.239	0.200
52.985	29.664	57.687	30292.925	*************	0.231	11.092	7.700	308.708	11.904	4.485	0.200
60.049	35.036	65.265	45774.627	*************	0.229	11.266	7.700	402.093	14.248	4.219	0.200
67.231	49.612	74.252	35297.466	*************	0.228	11.242	7.700	484.468	16.788	2.722	0.200
50.912	30.874	69.207	17560.507	50437.075	0.225	11.002	7.700	533.759	18.862	6.684	0.200
40.275	22.660	54.329	8858.734	16279.969	0.220	10.060	7.700	536.760	19.927	2.239	0.200
32.567	16.758	40.639	5880.466	8802.905	0.206	9.913	7.700	492.666	19.705	4.485	0.200
29.840	14.490	32.909	6026.134	9435.528	0.211	10.121	7.700	413.292	18.254	4.219	0.200
30.852	14.928	32.164	7370.432	13276.279	0.223	10.077	7.700	319.907	15.953	2.722	0.200
34.880	17.123	37.029	8957.515	18203.882	0.227	9.976	7.700	237.532	13.404	6.685	0.200
40.612	19.924	45.921	9616.914	20133.611	0.230	10.033	7.700	188.241	11.271	2.239	0.200
38.956	19.370	44.886	12275.299	31327.593	0.237	10.487	7.700	181.907	10.136	4.402	0.200
43.353	22.550	46.892	18716.932	63391.296	0.236	10.797	7.700	217.149	10.199	3.052	0.200
51.215	28.413	55.384	28526.051	*************	0.231	11.011	7.700	290.936	11.515	2.322	0.200
58.622	33.965	63.730	42984.323	*************	0.229	11.246	7.700	383.496	13.742	1.788	0.199
68.523	41.662	83.561	39433.355	*************	0.229	11.219	7.700	470.028	16.297	2.323	0.199
52.750	32.484	71.340	19707.773	62175.199	0.228	11.100	7.700	527.347	18.514	4.402	0.199
41.190	23.531	56.296	9790.687	19543.888	0.222	10.382	7.700	540.093	19.812	3.052	0.199
33.451	17.486	42.810	6005.706	9129.080	0.206	9.722	7.700	504.851	19.854	2.323	0.199
29.873	14.585	33.537	5892.029	9104.521	0.209	9.744	7.700	431.064	18.628	1.788	0.199
30.347	14.664	31.757	7087.329	12473.550	0.221	9.867	7.700	338.504	16.455	2.322	0.199
34.061	16.701	35.875	8701.284	17373.634	0.229	10.113	7.700	251.971	13.901	4.403	0.199
39.812	19.531	44.263	9616.914	20133.611	0.230	10.196	7.700	194.653	11.635	3.052	0.199
41.753	20.482	48.833	9616.914	20133.611	0.230	10.191	7.700	181.437	10.710	3.383	0.199
41.989	23.197	47.875	18327.861	63852.225	0.226	10.548	7.700	347.276	14.724	3.357	0.222



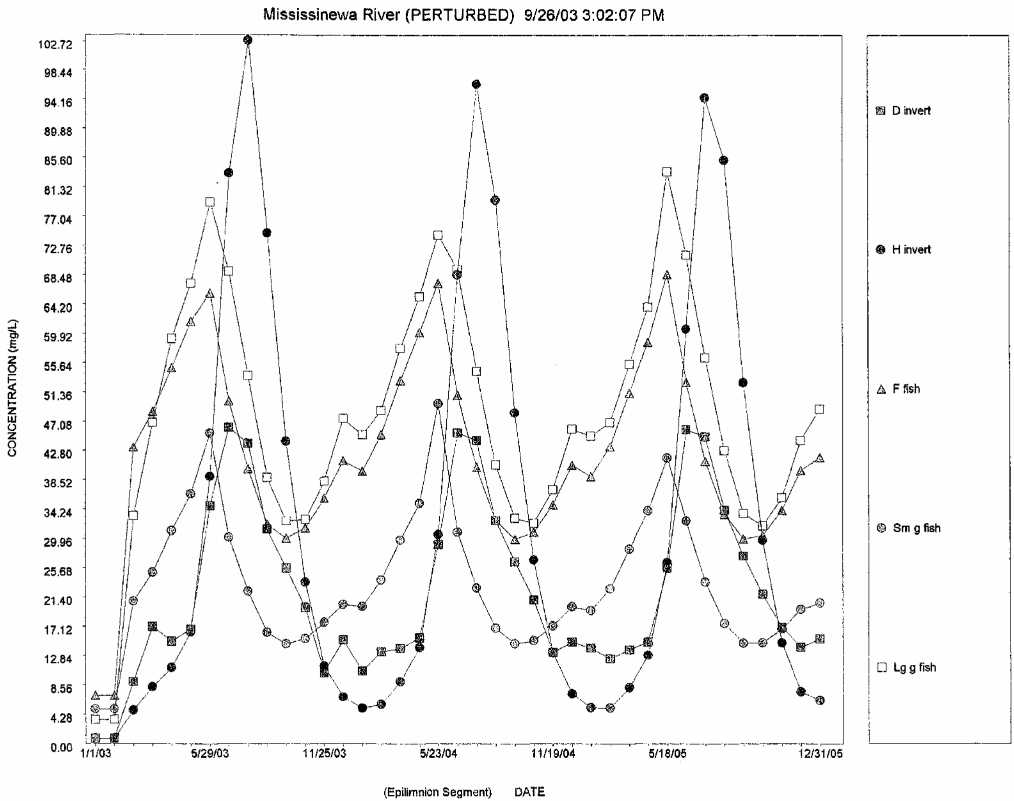
Elkhorn Creek
% DIFFERENCE
26.12
24.16
22.20
20.24
18.28
16.32
14.36
12.40
10.44
8.48
6.52
4.56
2.60
0.64
-1.32
-3.28
-5.24
-7.20
-9.16
-11.12
-13.08
-15.04
-17.00
1/1/03
1/29/03
3/30/03
5/29/03
7/28/03
9/26/03
11/25/03
12/31/03
DATE
Diatoms(g/m2)
D invert
F fish
Sm g fish
Secchi d



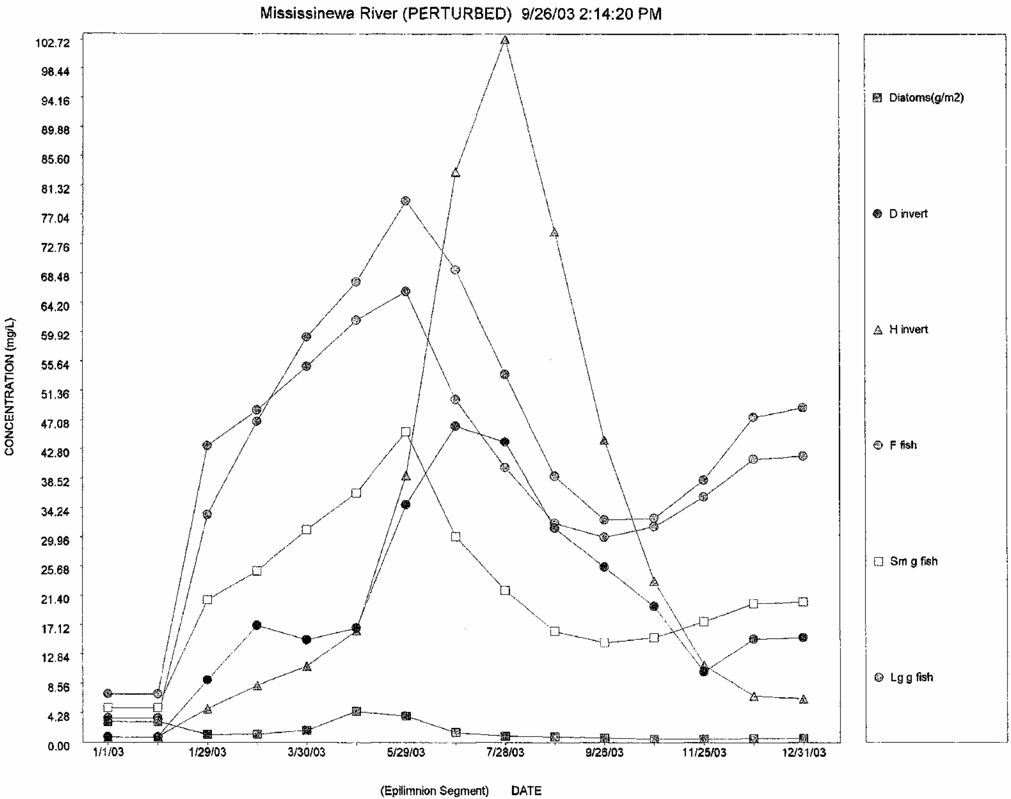
Mississinewa River
% DIFFERENCE
8.58
8.12
7.66
7.20
6.74
6.28
5.82
5.36
4.90
4.44
3.98
3.52
3.06
2.60
2.14
1.68
1.22
0.76
0.30
-0.16
-0.62
-1.08
-1.54
-2.00
1/1/03
5/29/03
11/25/03
5/23/04
11/19/04
5/18/05
12/31/05
DATE
Bl-greens
H invert
Lg g fish



Mississinewa River
% DIFFERENCE
5.90
5.60
5.30
5.00
4.70
4.40
4.10
3.80
3.50
3.20
2.90
2.60
2.30
2.00
1.70
1.40
1.10
0.80
0.50
0.20
-0.10
-0.40
-0.70
-1.00
1/1/03
1/29/03
3/30/03
5/29/03
7/28/03
9/26/03
11/25/03
12/31/03
DATE
D invert
H invert
F fish
Lg g fish



Mississinewa River (PERTURBED) 9/26/03 3:02:07 PM
CONCENTRATION (mg/L)
102.72
98.44
94.16
89.88
85.60
81.32
77.04
72.76
68.48
64.20
59.92
55.64
51.36
47.08
42.80
38.52
34.24
29.96
25.68
21.40
17.12
12.84
8.56
4.28
0.00
1/1/03
5/29/03
11/25/03
5/23/04
11/19/04
5/18/05
12/31/05
(Epilimnion Segment) DATE
D invert
H invert
F fish
Sm g fish
Lg g fish



Mississinewa River (PERTURBED) 9/26/03 2:14:20 PM
CONCENTRATION (mg/L)
102.72
98.44
94.16
89.88
85.60
81.32
77.04
72.76
68.48
64.20
59.92
55.64
51.36
47.08
42.80
38.52
34.24
29.96
25.68
21.40
17.12
12.84
8.56
4.28
0.00
1/1/03
1/29/03
3/30/03
5/29/03
7/28/03
9/26/03
11/25/03
12/31/03
(Epilimnion Segment) DATE
Diatoms(g/m2)
D invert
H invert
F fish
Sm g fish
Lg g fish

Public meeting attendance

PRESS RELEASE – November 20, 2003

The Soil and Water Conservation Districts of Randolph and Delaware Counties are sponsoring a "diagnostic study" of the Mississinewa River watershed between Ridgeville and Albany. The study, funded by a boat user fee administered by the Indiana Department of Natural Resources, is designed to help the districts measure the ecological health of the watershed, to determine areas of impact, and to make plans to improve water quality if necessary.

Results of the study are being presented at a public meeting at Delta Middle School at 6:30 p.m. on November 20, 2003. The study will show that this section of the Mississinewa River is in relatively good condition. A diverse and abundant fish community is present and the river supports many pollution-intolerant aquatic species. The study recommends that future efforts be directed to protecting and enhancing this excellent aquatic resource.

Future efforts to protect the watershed may include reduction of nutrients and bacteria, which can reach high levels during wet weather. The plan identifies four tributaries where water quality could be improved by implementing "best management practices" such as grassed waterways, stream bank stabilization, and wetland restoration. Funding for these practices could come from several government programs designed to improve water quality from storm water runoff.

Greg Bright

From: "BONNIE NASH" <BNASH@dem.state.in.us>
To: "ART GARCEAU" <AGARCEAU@dem.state.in.us>; "CAROL NEWHOUSE" <CNEWHOUS@dem.state.in.us>; "JIM STAHL" <JSTAHL@dem.state.in.us>; "LEE BRIDGES" <LBRIDGES@dem.state.in.us>; "SYED GHIASUDDIN" <SGHIASUD@dem.state.in.us>
Cc: "KERI MCGRATH" <KMCGRATH@dem.state.in.us>; "LAURA PIPPENGER" <LPIPPENG@dem.state.in.us>
Sent: Wednesday, November 19, 2003 8:25 AM
Subject: Muncie Star Press re: Mississinewa

Mississinewa in OK condition

THE STAR PRESS

MUNCIE - Results of a diagnostic study of the Mississinewa River watershed between Ridgeville and Albany will be presented to the public at 6:30 p.m. Thursday at Delta Middle School.

The soil and water conservation districts of Delaware and Randolph counties sponsored the study, funded by a boat user fee administered by the Indiana Department of Natural Resources.

The study showed that this section of the river was in relatively good condition, according to Shareen Goldman of the Delaware County SWCD. A diverse and abundant fish community was found, and the river supported many pollution-intolerant species.

The study recommends that future efforts be directed toward protecting and enhancing the river.

Future efforts might include reduction of nutrients and bacteria, which can reach high levels during wet weather.

The plan identifies four tributaries where water quality could be improved by implementing "best management practices" such as grassed waterways, stream bank stabilization and wetland restoration.

Upper Mississinewa River Watershed Project

PUBLIC MEETING!

Thursday, November 20, 2003
6:30pm
Delta Middle School
9800 N CR 200 E, Muncie

The Upper Mississinewa River Watershed Project, Phase II (see map) is almost completed. The Delaware and Randolph County Soil & Water Conservation Districts will be hosting a Public Meeting to present the results and recommendations of the Diagnostic Study for the Phase II area. A brief overview of the Phase III area of study will also be presented.

This study has analyzed historical data, current water quality sampling and existing land use within the Mississinewa River Watershed encompassing portions of Jay, Randolph and Delaware counties. The results will show where there are water quality problems or successes and what we can do in future phases of the project to improve the water where we live.

The Upper Mississinewa River Watershed Project is funded by Indiana Department of Natural Resources Lake and River Enhancement Grant; the Randolph and Delaware County SWCD's; Delaware County Commissioners and The Community Foundation of Muncie and Delaware County.

Upper Mississinewa River Watershed Project

Meeting Reminder

Steering Committee, Tech Committee and SWCD Boards – November 13, 1:00pm. Albany Town Hall. Pre-Public Meeting with Greg Bright, Commonwealth Biomonitoring. Greg will present to the committee and the board members the findings of the diagnostic study prior to the public presentation. Input and opinion is greatly wanted as to what will go into the public meeting.

Steering Committee, Tech Committee – December 5, 9:00am, Albany Town Hall. Consultant Interviews. 9am – Commonwealth Biomonitoring, 10am - V3, 11am – Cedar Eden. All three have been asked to bring a final report of a previous river study.

And of course don't forget about the Public Meeting, November 20, 6:30pm at Delta Middle School! Spread the word, bring your friends and neighbors!

INDIANA Water Environment Association

Indiana Water Environment Association

www.indianawea.org

SIGN-IN

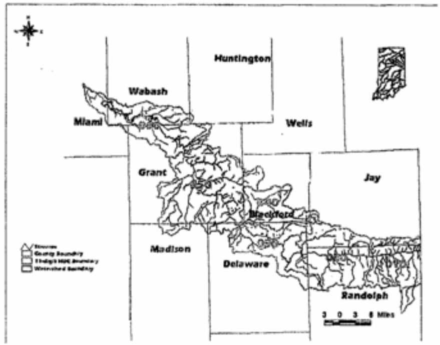
Mississinewa II – 11/20/03

	Name	Address
1	Greg Bright	8061 Windham Lake Dr., Indianapolis
2	Rachael Wilson	975 E WASHINGTON ST Winchester IN 47394
3	Jim Norris	975 E Washington St Winchester IN 47394
4	Richard J. Cooper	8425 N 750 W Ridgeville
5	Russell Calhoun	9390 W-300 N Parker City IN
6	Dan Alexander	1100 W. Eaton Wheeling Pike Muncie, IN. 4730
7	Joe Russell	3101 E CR 700N Muncie IN 47303
8	Richard Reum	14700 E Co. RD 500 N Albany IN 47320
9	PAT LITTLER	8191 CR 900 N ALBANY 47320
10	GARY PHILLIPS Kathy Miller	14800 N SR 167 N ALBANY 47320
11	BEVERLY RENNER	10858 W. RIVER Rd. RIDGEVILLE 47380
12	MICHAEL H. MILLER	1030 EAST CASE BLVD. ALBANY, IN 47320
13	Sam Taylor	PO Box 49 Upland 46989
14	Kirby Hall	Taylor University
15	Melissa Werner	Taylor University
16	BRYAN BEEH	TAYLOR UNIVERSITY
17	Michael Moore	Taylor University
18	Nathan Reynolds	Taylor University
19	JOHN CHRISTY	13200 N 675 W GASTON IN 47342
20	TED BOWMAN	7770 E. ST. RD. 67 ALBANY IN. 47320
21	RON QUAKENBUSH	YORKTOWN 47396
22	Shar[illegible] Goldner	Del Co. SWCD
23	Dewayne [illegible]	390 W. Albany Ct. Albany IN 47320
24	Mike Gaebert	Taylor University Upland IN
25	Larry Person	Parker Ind Randolph Co Supervisor
26	Richard Pegg	Winchester In Randolph Co. Supervisor
27	Jim Farr	IDNR Soil Conservation
28	Melody Myers-Kinzie	Brownsburg, IN
29		
30		
31		
32		
33		
34		
35		

Project Information Handouts

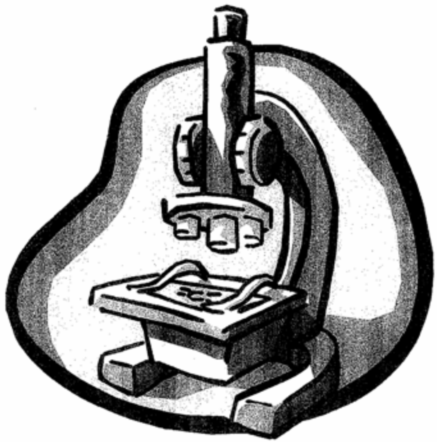
Mississinewa Watershed Diagnostic Study

- What is a "diagnostic" study?
- Why was it done?
- What did we find out?
- What do we do now?

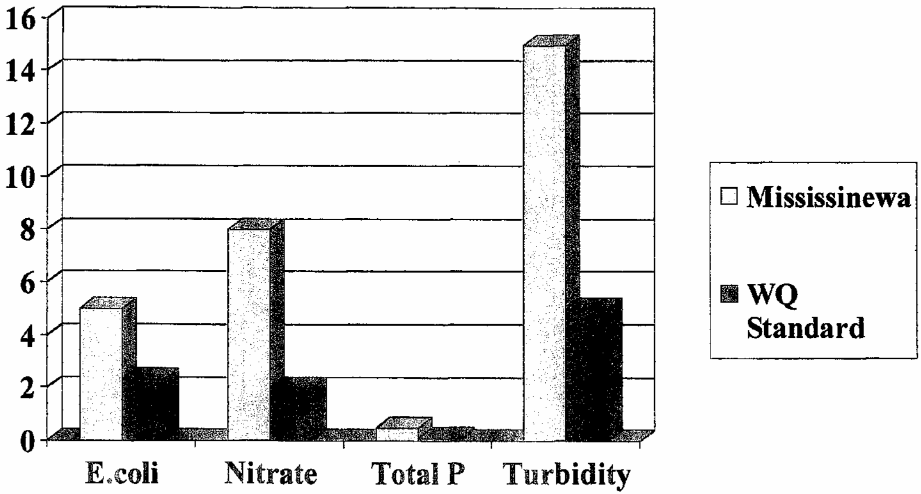


What is a diagnostic study?

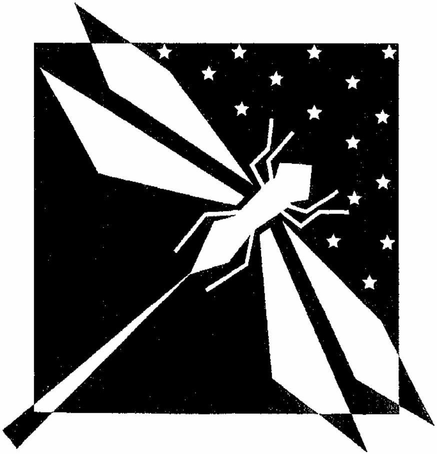
- A DNR program funded by boat users
- A natural resource management tool
- Designed to identify water quality problems
- Designed to help fix water quality problems



Why was it done?



What was done in this study?



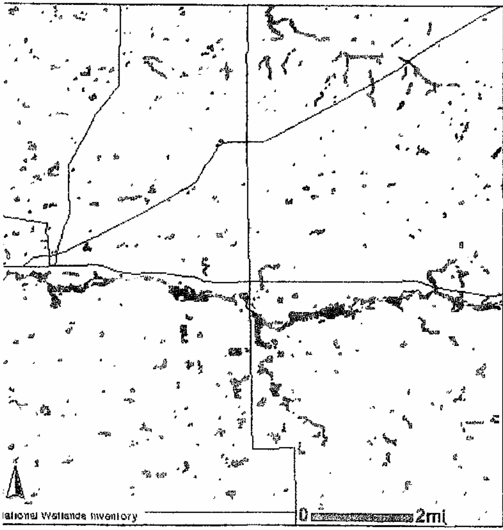
- Gather information
- Monitor water quality
- Predict changes with BMP implementation
- Prioritize areas that need attention
- Recommend fixes
- Educate

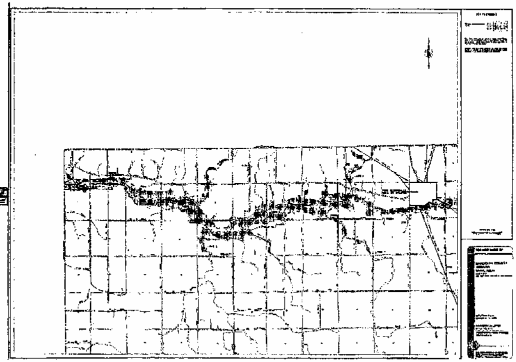
Information about the watershed

Wetlands	Land Use
Flood Plains	Natural Resources
Water Quality	Soils

Wetlands

Flood Plain





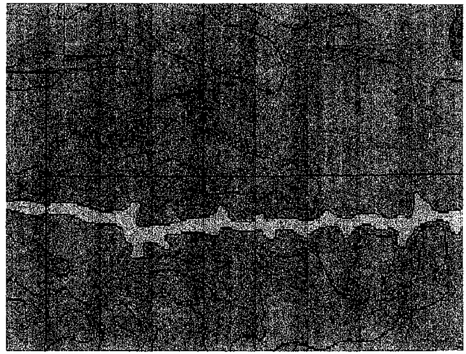
Land Use

Yellow = Corn

Green = Soybeans

Dark Green = Forest

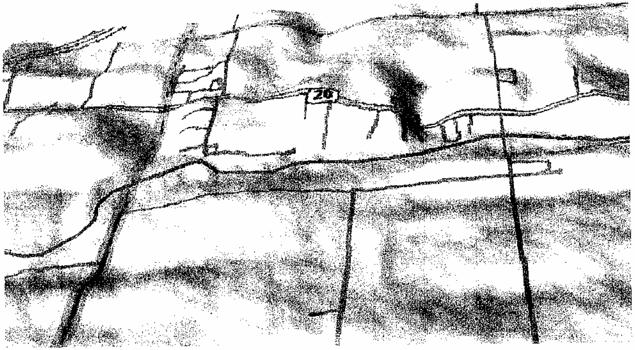
Soils

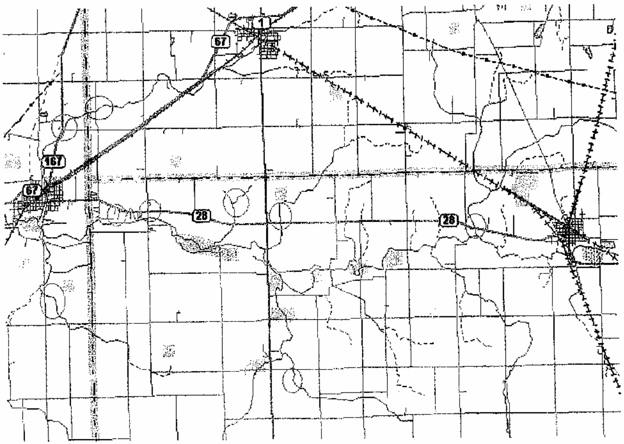


Red = silt loam on steep slopes

Green = silt clay on low slopes

Blue = loam on stream terraces



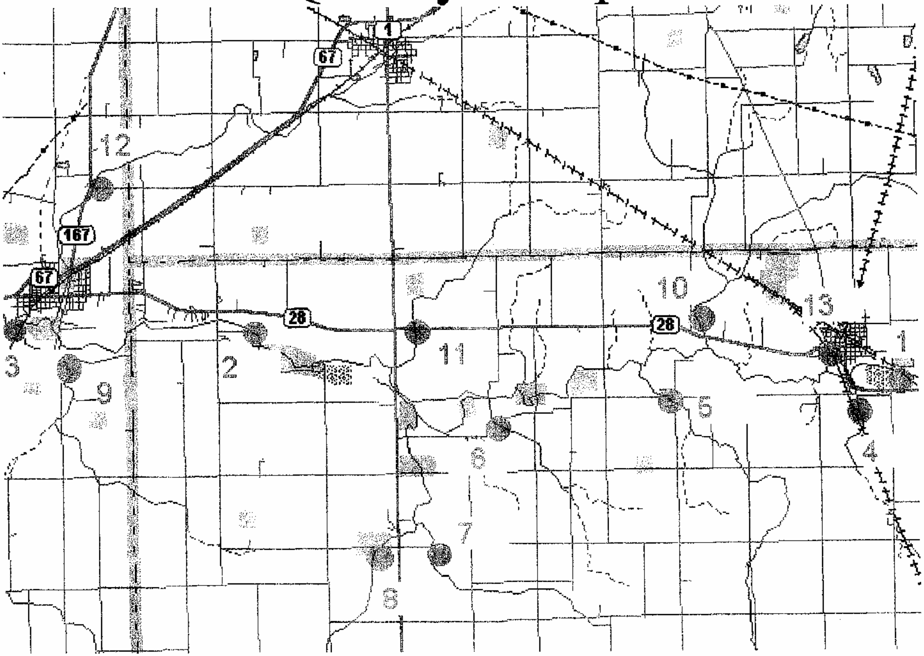


Highly Erodible Land

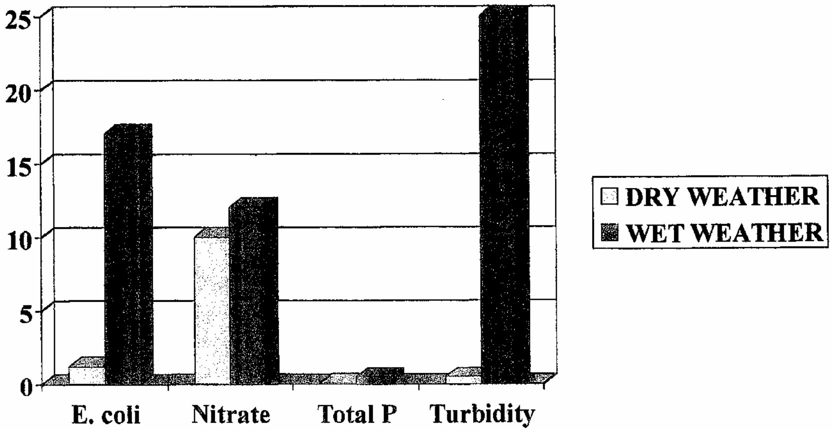
Natural Resources – Rare Species

Mammal	LYNX RUFUS	BOBCAT	SE	**	T21NR11E 2 MI	1984
Mammal	MYOTIS SODALIS	INDIANA BAT OR	SE	LE	T21NR11E 20	1990
Plant	RUDBECKIA FULGIDA VAR FULGIDA	ORANGE CONEFLOWER	SR	**	T21NR12E 13 & 14	1938
Bird	ARDEA HERODIAS SEQ	GREAT BLUE HERON	**	**	T21NR12E 23	1993
Forest	FOREST - FLATWOODS CENTRAL TILL PLAIN	CENTRAL TILL PLAIN FLATWOODS	SG SEQ	**	T21NR12E 23	1980

Water Quality Sample Sites



Water Chemistry



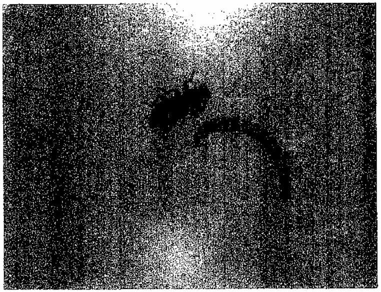
cells/ml mg/l mg/l NTU/10

Biology – Fish Community

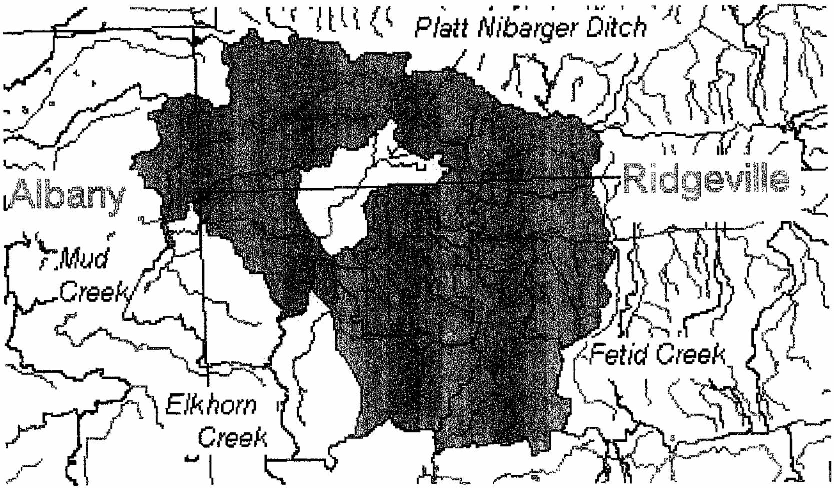
Many pollution-intolerant species present

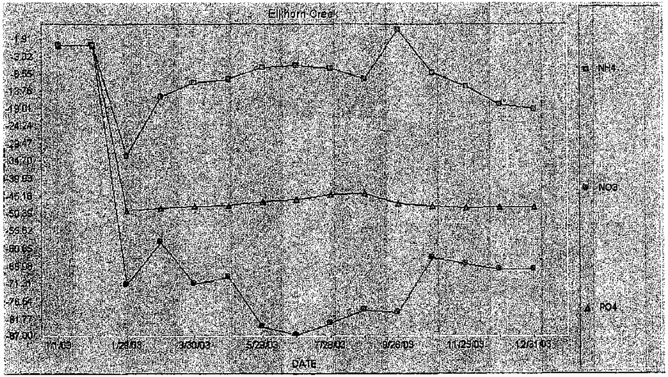
"Index of Biotic Integrity" is high

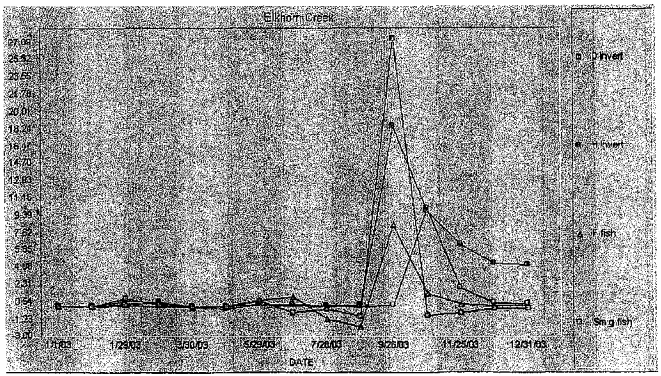
Biology - Macroinvertebrates



Impaired Biological Community

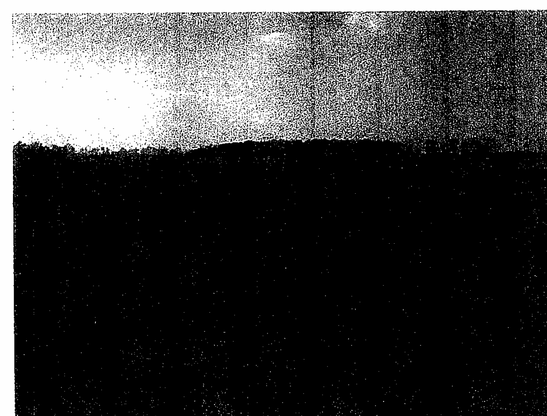






Computer Model: Changes with BMP Implementation

What kinds of BMPs are possible?



Education

Now What?

- Do nothing?

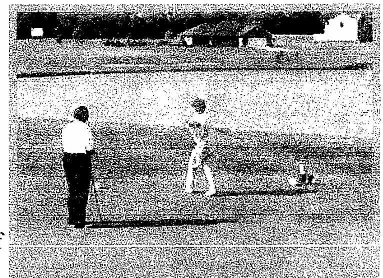
- Continue water quality education programs
- Apply to DNR for land treatment grant funds
- Carry out BMP practices
- Check for progress in five years

TheStarPress.com
East Central Indiana
LOCAL NEWS

Monday, June 9, 2003

IDEM halts condo construction

By SETH SLABAUGH
seths@thestarpress.com



Kenny Lehman (left) watches his brother Marvin tee-off on the 14th hole Sunday at the Albany Golf Club where condominium construction has been halted because of the townÕs sewage problems.
Joe Krupa

ALBANY - The Indiana Department of Environmental Management has stopped the construction of condominiums at On the Fairways, a new golfing community, because of the town's sewage problems.

Partners Don Hamilton and Stan Richards expected their Condos on the Fairways, 35 condominiums containing 70 living units, to be well under development by now.

Instead, not a single condo has been built, and all the money the partners invested in architects, engineers, surveyors, and acceleration and deceleration lanes on Ind. 67 has "gone out the window," Hamilton said.

"We spent all this money to do this, and now we're just sitting here with dead money," Richards said. "We're ready to go, but our money is doing nothing."

Several years ago, IDEM approved the construction of On the Fairways, which is connected to the town's sewer system. About 40 single-family homes have been built so far.

But the agency has declined to issue a sewer construction permit for the condominium project because of the town's sewage difficulties, which resulted in IDEM issuing a notice of violation to Albany in 2000.

According to Bruno Piggot, chief of the permits branch in IDEM's office of water quality, the town reported to IDEM that it had bypassed or diverted untreated wastewater from the town's sewage treatment plant into the Mississinewa River 42 times last year.

The year before that, the town reported 31 bypasses, and the year before that it reported 19 bypasses, and the year before that it reported 39 bypasses, and the year before that it reported 32 bypasses.

Every time a bypass occurs, typically during wet weather, the river is polluted with bacteria, heavy metals and other pollutants.

Sen. Allie Craycraft, D-Selma, helped arrange a meeting between state and town officials and the developers weeks ago.

"For a construction permit to be issued, the town has to certify that it can accept the flow from the new development," Pigott said. "Based on that [excessive bypass] data, there is now way the town can certify that it can accept this additional wastewater."

The town can ask for a variance from the certification requirements.

Albany has signed an order with IDEM agreeing to invest more than $5 million in sewage and drainage improvements, including the construction of two, 10-million-gallon wastewater lagoons or surge basins.

"The community is working diligently to make those proposed improvements," Piggot said. "We are willing to, and have sat down with them once already and will do so again, to talk about projects they could engage in in addition to the work they are undertaking now, to more than offset this additional flow.

"The planned improvements probably won't get completed very quickly, so if the town could identify several other projects they could undertake in the meantime, then we could talk to them about a variance."

Marita Fields, Albany clerk-treasurer, referred questions to the town council president, who couldn't be reached for comment.

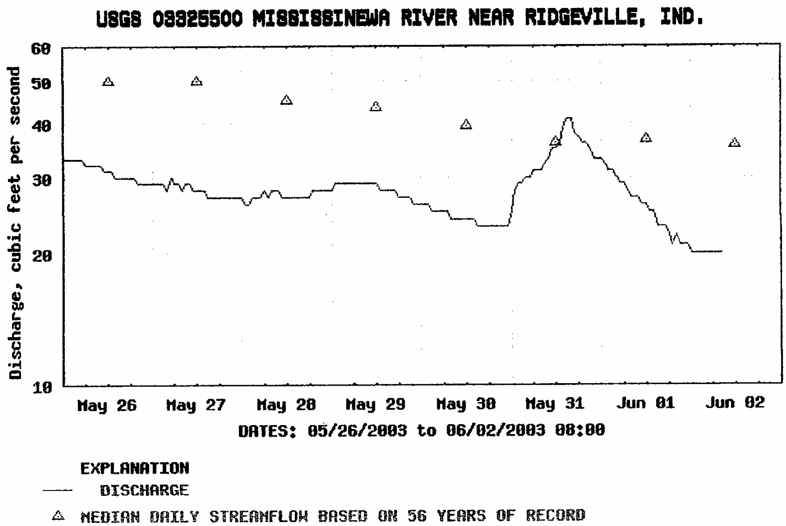
Contact news reporter Seth Slabaugh at 213-5834.

SEWAGE BANS, WARNINGS

Two dozen Indiana communities have been banned from obtaining sewer construction permits from IDEM because of excessive sewage bypassing into water bodies or lack of sewage treatment plant capacity. The only communities in East Central Indiana that have been banned are Upland (north lift station only) and Van Buren, both in Grant County. About 75 other communities have received "sewer ban early warning notifications," which are not as serious as a

Water chemistry data sheets

USGS



Provisional Data Subject to Revision

Mississinewa watershed

(base flow)

Phosphorus

Calibration

Date ~~5/30/02~~ 5/30/03

	0.05 mg/l-P	Absorbance	
0.16	~~0.5~~ mg/l-P	Absorbance	67
1.6	~~5~~ mg/l-P	Absorbance	9

Sample #	Absorbance	Phosphorus (mg/l)
1	71	0.14
2	84	0.08
3	63	0.19
4	60	0.21
5	71	0.14
6	71	0.14
7	~~60~~ 65	~~0.24~~ 0.18
8	60	0.21
9	73	0.13
10	73	0.13
11	50	0.28
12	43	0.35
Ridge	50	0.28

Mississinewa watershed

Nitrate

Calibration

Date 5/30/03

0.5 mg/l-NO3 Absorbance
5 mg/l-NO3 Absorbance
50 mg/l-NO3 Absorbance

Sample #	Absorbance	Nitrate (mg/l)
1	12	15
2	17	10
3	14	13
4	18	9.7
5	31	5.0
6	20	9.0
7	56	2.1
8	23	7.5
9	27	6.5
10	16	11
11	12	15
12	19	9.5
Ridge	47	2.8
CSO	77	0.85

→ cond = 1700 μS

Mississinewa watershed

BACTERIOLOGICAL DATA
M-ColiBlue 24 Procedure

SAMPLING DATE/TIME 5/29/03
ANALYSIS DATE/TIME 5/30/03
DILUTION none

Data reported as "number counted/number per 100 ml"

SITE NUMBER		RED COLONIES	BLUE COLONIES	TOTAL COLONIES
1		≈1000	125	1125
2		≈200	60	260
3		≈500	398	898
4		≈2000	2250	4250
5		≈1000	89	1089
6		≈200	25	225
7		≈500	443	943
8		≈600	428	1028
9		≈300	72	372
10		≈500	156	656
11		68	3	71
12		≈400	58	458
13	Ridge Run	≈200	131	331
14	CSO	≈300(x100)	25(x100)	32,500
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				

Ammonia Analysis

Sample Location Mississinewa Watershed
Sample Date 5/29/03
Analysis Date 5/30/03

0.1 mg/l = +~~100~~5
1 mg/l = ~~+ 90~~ -45
slope = 50
10 mg/l = -95
100 mg/l = -145

Sample Number		mv	mg/l
1		+6	< 0.1
2		+2	0.1
3		+1	0.1
4		+1	0.1
5		0	0.1
6		-2	0.1
7		+3	0.1
8		+3	0.1
9		+3	0.1
10		+2	0.1
11		+3	0.1
12		+~~3~~4	0.1
13	Ridge	+4	0.1
14	CSO	-111	20.9

Mississinewa watershed

Chlorphyl a - Fluorometer

Date 5/30/03

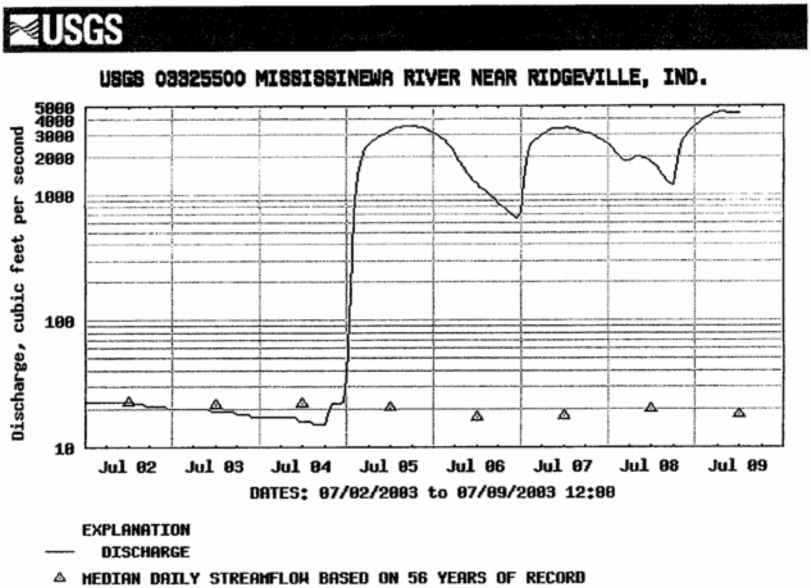
Sample #	Chlorophyl a (ug/l) (divide by 10)
1	290
2	451
3	437
4	273
5	333
6	332
7	323
8	276
9	209
10	206
11	416
12	301
Ridge	399
CSO	1205

Mississinewa watershed

Turbidity by Fluorometer

Date 5/30/03

Sample #	Turbidity (NTU)
1	4.8
2	5.2
3	7.7
4	4.8
5	4.3
6	4.2
7	4.3
8	3.3
9	4.3
10	3.8
11	13.7
12	5.1
Ridge	4.7
CSO	77



Provisional Data Subject to Revision

Mississinewa
wet weathe

Ammonia

Calibration

Date 7/5/63

0.1 mg/l-NH3 +14 mv
1 mg/l-NH3 -35 mv
10 mg/l-NH3 -84 mv

Slope 49

Slope 49

Sample #	mv	Ammonia-N (mg/l)
1	+3	0.2
2	0	0.2
3	-6	0.3
4	~~-15~~ -16	0.4
5	0	0.2
6	-4	0.3
7	-8	0.3
8	-8	0.3
9	-9	0.3
10	-8	0.3
11	-22	0.5
12	-20	0.5
13	0	0.2
Ridge	+18	<0.1
9 dupl.	-9	0.3

Mississinewa
wet weather

Nitrate

Calibration

Date 7/5/03

0.5 mg/l-NO3 Absorbance
5 mg/l-NO3 Absorbance
50 mg/l-NO3 Absorbance

530 nm

Sample #	Absorbance	Nitrate (mg/l)
1	31	5.0
2	15	12
3	21	8.5
4	37	4.0
5	47	2.8
6	55	2.1
7	25	7.0
8	11	17
9	21	8.5
10	21	8.5
11	12	14
12	9	21
13	18	10
Ridge	50	2.5

Mississinewa
wet weather

Phosphorus

Calibration

Date 7/5/03

	0.05 mg/l-P	Absorbance		660 nm
0.16	0.5 mg/l-P	Absorbance	67	
1.6	~~5~~ mg/l-P	Absorbance	9	

Sample #	Absorbance		Phosphorus (mg/l)
1	17		
2	29		0.55
3	37		0.42
4	26		0.65
5	30		0.53
6	33		0.48
7	39		0.39
8	29		0,55
9	27	21	0.60, 0.75
10	31		0,52
11	32		0.50
12	39		0.39
13	21		0.75
Ridge	48		0.30

BACTERIOLOGICAL DATA
M-ColiBlue 24 Procedure

Mississinewa
wet weather

SAMPLING DATE/TIME 7/5/03 11 a.m → 3 p.m
ANALYSIS DATE/TIME 7/5/03 6 p.m.
DILUTION 20:1

Data reported as "number counted/number per 100 ml"

SITE NUMBER	RED COLONIES	BLUE COLONIES	TOTAL COLONIES
1 Ridgeville	≈400 x 20	86 x 20 (1720)	9700
2 Renner	≈300 x 20	79 x 20 (1580)	7600
3 Albany	≈300 x 20	182 x 20 (3640)	9600
4 Fetid Cr.	≈300 x 20	122 x 20 (2440)	8400
5 Bear Cr.	≈300 x 20	148 x 20 (2960)	9000
6 Heuss D.	≈300 x 20	136 x 20 (2720)	8800
7 Bush Cr	≈200 x 20	64 x 20 (1280)	5300
8 Elkhorn Cr.	≈1000 x 20	285 x 20 (5700)	26,000
9 Mud Cr.	≈500 x 20	24 x 20 (480)	10,500
10 Days Cr.	≈300 x 20	12 x 20 (240)	6200
11 Platt Nibarger	≈400 x 20	104 x 20 (2080)	10,100
12 Halfway	≈400 x 20	309 x 20 (6180)	14,200
13 Stoney	≈400 x 20	270 x 20 (5400)	13,400
14 Ridge Run	≈600 x 20	267 x 20 (5340)	17,300
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			

Turbidity by Fluorometer

Date 7/5/03

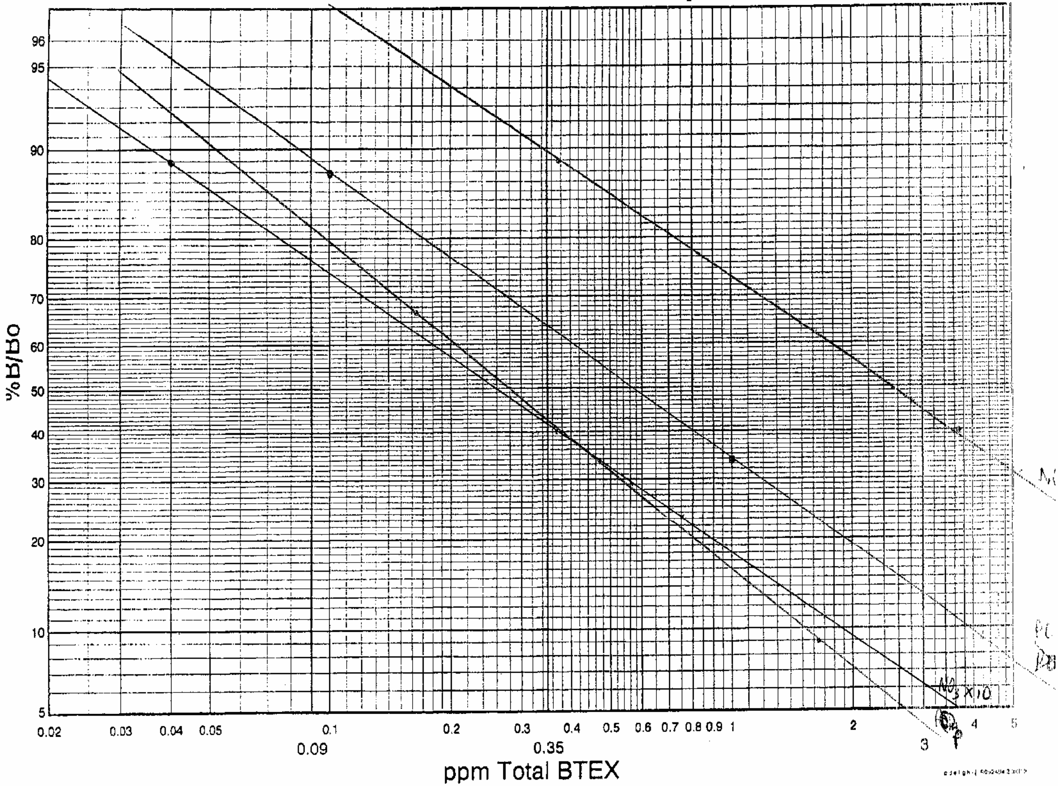
Sample #	Turbidity (NTU)
1	62 x 4 = 248
2	54 x 7 = 378
3	92 x 4 = 368
4	58 x 4 = 232
5	56 x 4 = 224
6	65 x 5 = 325
7	63 x 5 = 315
8	41 x 4 = 164
9	33 x 4 = 132
10	42 x 5 = 210
11	34 x 4 = 136
12	44 x 4 = 176
13	14 x 4 = 56
Ridge Run	59 x 4 = 236

Chlorphyl a - Fluorometer

Date 7/5/03

Sample #	Chlorophyl a (ug/l)
1	191
2	207
3	217
4	183
5	180
6	221
7	224
8	168
9	144
10	169
11	164
12	166
13	127
Ridge Run	176

Total BTEX RaPID Assay(R)



Photographs of all study sites

Site 1- Mississinewa near Ridgeville

Site 2 - Mississinewa middle

Site 3 - Mississinewa near Albany

Site 4 - Fetid Creek

Site 5 - Bear Creek

Site 6 - Heuss Ditch

Site 7 - Bush Creek

Site 8 - Elkhorn Creek

Site 9 - Mud Creek

Site 10 - Days Creek

Site 11 - Platt Nibarger Ditch

Site 12 - Halfway Creek